"Wood Pavement in the Metropolis."

BY GEORGE HENRY STAYTON, ASSOC. M. INST. C. E.

(*Continued from page 244.*)

Laying, Jointing, and Completion.—Great diversity of practice has existed in the mode of laying and jointing, and a great deal of money has been lost in the acquisition of patented inventions. Under some of the latter systems the blocks were laid on boards upon a foundation of sand, in others the blocks were laid upon a layer of asphalt, or upon tarred felt placed upon a concrete foundation. Blocks have been laid in transverse courses, and, under Lloyd's "keyed" system, diagonally. Various modes of jointing have been adopted, technically known as mastic, semi-mastic, cement, lime, or felt, the latter being a close-joint, while the former varied from ¼ inch to 1 inch in width.

In the Chelsea pavements the dimensions of the blocks were 3 inches by 9 inches by 6 inches, 40.5 being required for each square yard, and they were laid upon the concrete in their natural state, with the fibres vertical, and with intervening spaces ⅜ inch wide, which were filled with cement grout. The surface of the concrete having become hard and smooth, the method of operation consisted in laying two longitudinal courses of blocks next to the kerb to form the channels, and filling in with straight courses transversely, the ends of the blocks being in contact. At the intersections of streets the courses were laid V shape, so as to ensure the traffic passing over the blocks at an angle of 90°, or as nearly as possible thereto (Fig. 2). In laying the blocks, the joint was kept parallel by means of three cast-iron studs fixed in each block (Figs. 3 and 4), which materially assisted in keeping the pavement firm and steady until the grouting had thoroughly set. By the use of studs instead of wooden strips or laths, it is certain that the blocks are much less liable to become displaced while the work is setting, and in practice a uniform width of joint is more easily secured.

FIG. 4.

FORM OF STUD.
Full size.

The grout was composed of 3 parts of Thames sand to one part of Portland cement, the materials being measured in boxes and mixed to a proper consistency, in a large movable grout truck. The grout having been swept out of the truck on to the surface of the wood, was swept backwards and forwards until every joint was properly filled. The prime cost of this work, labor and materials, amounted to 5*d.* per square yard.

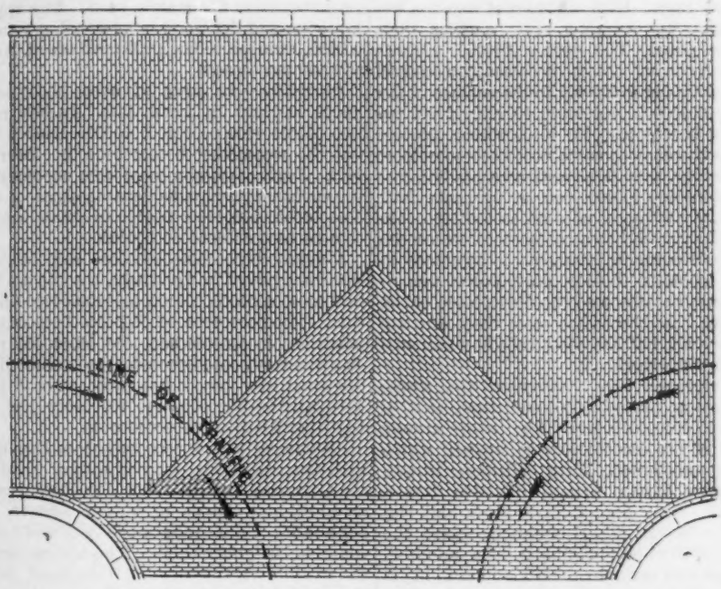


FIG. 2.—MODE OF BLOCKING AT INTERSECTING STREETS.

Before permitting vehicular traffic to pass over new work, it is desirable to "top-dress" the surface of the wood with a fine gritty material. This is usually done by spreading a thin coating of very small stones, as screened from Thames ballast, sand, or shingle, over the entire surface, and leaving it to be crushed and ground into the fibres of the wood by the traffic, until it has ceased to be gritty. The cost of this work for the Chelsea pavements amounted to 2*d.* per square yard for materials and labor. Whenever practicable all traffic should be excluded from a newly laid pavement for at least a week after completion, but there is an obvious difficulty in the enforcement of this rule, whenever a street is too narrow to allow the works to be carried out in half-widths at a time.

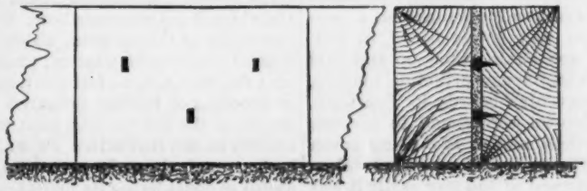


FIG. 3.—MODE OF JOINTING.

The expansion of wood is a question demanding consideration in carrying out such works. In unprepared blocks this is specially necessary, and to proportion to the width of the street so is it desirable to leave a space next the footways, varying from 1 inch to 2 inches in width. The actual condition of the wood and the state of the atmosphere at the time of laying, exercise a material influence upon the width of the margins thus left. Another mode is by omitting to grout the channels for a week or longer period after the other portions have been completed; and another by paving nearly up to the kerb, and afterwards taking out the nearest course so soon as expansion sets up. In any case, it is necessary to temporarily fill up the margin with sand or other suitable material, which can be raked out from time to time until expansion ceases, which generally occurs in the course of twelve to eighteen months from completion. In the Chelsea works it was then found desirable to rake out the temporary filling, and where any space was left, to fill in with cement grout, the surface being carefully pointed in cement. This work effectually renders the channels impervious to water, and tends to prevent premature decay; and was executed at a cost equal to 0.86*d.* per square yard of pavement.

It frequently happens that, notwithstanding these provisions, and whether the blocks are plain and dipped, the outer portions of the footways become displaced during the period of expansion, but subsequent to the above-named period wood pavement generally maintains a fairly constant state. The author has never observed any contraction in wood pavement except during the severe frost in January 1881, at which time, when 22° of frost were registered, several rather alarming cracks in a longitudinal direction appeared in the Sloane Street pavement, at places where the wood was especially exposed to the severity of the weather. Immediately the frost terminated the cracks appeared to close up naturally, and the pavement assumed its former sound condition.

This plain system of pavement was laid in Sloane Street and King's Road in 1879, and upon closely observing the effect of nearly five years' traffic upon it, the result is eminently satisfactory. The plain type of pavement had previously been adopted by Messrs. Mowlem & Co., in several parts of the Metropolis, with the exception that their joint was wider and was formed of lime grout, and that their form and manner of studding were different, and the author ventures to assert that it comprises all the essentials of a sound pavement; a quiet and smooth surface for vehicles being provided, and the pavement being sufficiently close-jointed to insure a safe foothold for horses. Experience proves that the cement-joint is reliable, that it adheres to the blocks, effectually resists wet, and does not unduly wear down below the surface of the wood, and thereby allow dirt to accumulate in the joints, neither does it permit displacement of the blocks; the author therefore feels that he may justly pronounce it successful, and claim for it another advantage as compared with the mastic-joint, viz., the absence of the annoyances which are created by asphalt kettles in streets, during the execution of the works. Upon inspecting the numerous openings which have been made for gas and water services or drainage works, the actual condition of the wood and foundation has invariably proved satisfactory; the surface of the concrete is hard and dry, the joints are sound, and the blocks as a rule present a fairly good surface, and are not found to contain an excessive amount of moisture.

The prime cost of the pavement in King's Road and Sloane Street amounted to 10*s.* 6*d.* per square yard, and the only repairs which have been found necessary, consisted in the removal of some defective blocks during the past twelve months. The blocks were originally 5.87 inches deep, whereas their present average depth measures 5.22 inches in King's Road and 5.60 inches in Sloane atreet. The probable life of the blocks may be taken at seven years for King's Road and eight years for Sloane Street. The annual vertical wear of wood is equal to 0.144 inch in King's Road and 0.065 inch in Sloane Street, and if reduced to a traffic standard of 750 tons per yard width daily, the following results are obtained, viz.:—

King's Road.....	0.196 inch.
Sloane Street.....	0.175 "

Several other systems of pavement were laid in King's Road at the same time for the purpose of practically testing their respective merits. In one instance a layer of metallic lava asphalt ½ inch thickness was laid upon the concrete foundation, the blocks being laid and jointed as already described. Opposite the Royal Military Asylum wall creosoted blocks were adopted, one length being formed with a semi-mastic joint, namely, the lower-half bituminous mastic and the upper lias lime grout; the other being entirely jointed with grout composed of lias lime and sand. The section of pitch pine blocks previously described was also laid at this part, the joint consisting of Portland cement grout. The author has carefully examined the various experimental sections of pavement, the cost of which, together with the ascertained wear and other particulars, are as follows, viz, :—

(*a*) *Plain deal blocks on layer of Asphalt.*—The cost amounted to 12*s.* 4*d.* per square yard; the present depth of the blocks is 5¼ inches; the foundation is in perfect condition, and the blocks are fairly good. The estimated life of the pavement is seven years, the average annual wear being 0.139 inch.

(*b*) *Creosoted blocks, with mastic joint.*—The cost was 14*s.* 2*d.* per square yard; the present depth of the blocks is 5¼ inches, and the foundation is perfectly sound. The lime grout part of the joint has perished and almost crumbled away, consequently a good deal of dirt has been pressed into the part above the bituminous portion, and the blocks came up very easily. The pavement may last for eight years, the average annual wear being 0.139 inch.

(*c*) *Creosoted blocks, lime joints.*—The cost was 11*s.* 10*d.* per square yard; the blocks are 5¼ inches deep, and in a fairly good condition. The failure of the lime joint may possibly arise from a chemical action of the creosote; but it certainly has perished, and causes dirt to accumulate. The blocks will probably last eight years, the average annual wear being 0.111 inch,

(*d*) *Pitch-pine blocks.*—This section costs 11*s.* 8*d.* per yard, and the present depth of the blocks is 5¼ inches. The foundation is dry and sound, and the cement-joint perfectly satisfactory. The repairs to the blocks have been very slight, and they will probably last eight or nine years, the average annual wear being 0.055 inch only.

If reduced to a traffic standard of 750 tons per yard width per day, the figures are; Pavement (*a*) 0.209 inch; (*b*) 0.240 inch; (*c*) 0.204 inch: (*d*) 0.088 inch-

Practically, the plain pitch-pine pavement is cheaper than yellow deal, and the ascertained vertical wear promises admirable results: but it does not appear that either of the other modes is attended with any particular advantage.

Other Pavements.—In 1876, the Improved Wood Pavement Co., laid a short section in King's Road, near the Vestry Hall, in which planks were laid upon the concrete foundation, and "dipped" pitch-pine blocks were used; but in consequence of numerous complaints of the disagreeable rumbling and jarring noises which the rapid passage of vehicles over it caused, it was taken up and relaid without the boards after a period of seventeen months, an additional length being at the same time laid with "dipped" deal blocks. These pavements were subsequently particularly unfortunate, inasmuch as the "mastic" joint caused the surface to become uneven and bumpy, and rendered it necessary to execute frequent repairs, a considerable portion being relaid in 1882. Upon examination it transpired that the substance which formed the "mastic" joint had partially melted, presumably from the heat of the sun, and that the material had got underneath the blocks and forced them upwards. In November, 1883, the pitch-pine section was finally taken up, and the other portions were again repaired by the Company for the same cause. Like results may be seen in other districts, where a similar joint has been adopted.

The ascertained average depth of the pitch-pine blocks at the time of removal, was 5¼ inches, the average annual wear during a period of seven years being 0.089 inch, or if reduced to the traffic standard, 0,119 inch. The deal blocks were measured and found to be 5 inches deep, the ascertained annual wear being 0.157 inch, and according to the traffic standard, 0.195 inch. With additional repairs, the latter may last another year, making their life seven years. The author further objects to this form of joint, because the melted asphalt adheres so tightly to the surface of the concrete that it is necessary to chip it off before new blocks can be laid, which process destroys the smooth surface of the concrete so considerably, that it necessitates a bedding of sand before new blocks can be properly laid. Further, the bitumen adheres so tightly to the blocks that to well cleanse them for re-use not only involves much labor, but is injurious to them, especially if they have borne two or three years's traffic, and the fibres have begun to spread. In the latter case they are not only unsound, but are also unfit to make neat or satisfactory work.

The Improved Wood Pavement Co., whose experience is probably greater than that of any other company, have laid their system in many of the leading streets, among which may be mentioned, King William Street, Bishopsgate Street, Queen Victoria Street, Whitehall, Bond Street, Park Lane, and Old Brompton Road. In all instances where the patented system had originally been adopted, advantage was taken to modify and simplify it whenever it became necessary to renew the blocks. The company have entirely discontinued to lay a plank in the foundation, and now limit their system to the use of "dipped" blocks, laid with a semi-mastic joint upon a concrete foundation. For the purpose of comparison, the weight of the traffic being known, the following streets are referred to:—

Ludgate Hill.—Originally laid on boards in November, 1873, at a cost of 18*s.* per square yard. The terms of maintenance are, one year free, and fifteen years 1*s.* 6*d.* per square yard per annum. The blocks and plank foundation were taken up and new blocks laid on a concrete foundation and single board, in 1877. The pavement was again taken up and laid with new blocks on the new principle, namely, without the intervening boards, in February, 1884, when the blocks were found to average 3 inches deep, their actual life being seven years. The author saw this pavement taken up, and was surprised to find how easily it was removed; the mastic joint had evidently lost its strength, and the result possibly points to the fact that its efficient durability does not extend beyond a limited period. The annual average wear of the last-mentioned wood was 0.428 inch, and if reduced to the traffic standard it was equal to 0.259 inch.

Aldersgate Street.—Cost 15*s.* per square yard in September, 1874; the maintenance terms being two years free, and fifteen years at 1*s.* per square yard per annum. It was taken up and relaid on a concrete foundation in 1877, the blocks being merely reversed and laid on lias lime mortar. In March, 1884 the blocks were renewed, the average depth then being 3½ inches; but in some parts the wood was only 2 inches thick. The annual wear was equal to 0.263 inch, and the actual life of many of the blocks was no less than nine and a half years. The blocks recently laid are 5 inches deep.

Northumberland Avenue.—Paved in February, 1876, at a cost of 15*s.* per square yard, exclusive of the concrete foundation, which has been laid by the Metropolitan Board of Works. It is maintained by the Company at the rate of 13*s.* per square yard for fifteen years. Baltic pine blocks, 6 inches deep, were laid on planks, and the approximate wear is 0·125 inch per annum. The surface is uneven, and shows considerable wear at the upper end, but its life will probably be nine years.

Leadenhall Street.—In July 1876 the western end was paved at a cost of 12*s.* 3*d.* per square yard, with two years' free maintenance, and fifteen years at 1*s.* per square yard per annum. The pavement was taken up, and 5 inch blocks laid in 1879, without the planks. The wood is considerably worn and the surface is bumpy, probably from the mastic joint. The approximate wear of the wood is 0.200 inch per annum, which, reduced to the traffic standard, is equal to 0.186 per annum.

Piccadilly.—An area of over 16,000 square yards was laid in April, 1876. In 1880 nearly two-thirds were renewed, and the boards taken out, the remainder being done in February, 1882. Further repairs have been executed, and the surface shows considerable signs of wear. The author has been unable to obtain information as to the depth of blocks.

Knightsbridge.—The portion east of Albert Gate was paved in April 1878, the blocks being laid upon a single plank, and concrete foundation. The part west of Wilton Crescent was taken up in September, 1883, when the plank was removed, consequently the actual life of the wood was nearly five and a half years. The daily traffic is about 780 tons per yard width, or 250,000 tons per annum,

Parliament Street was paved in December, 1880, at a cost of 13*s.* 8*d.* per square yard, and the Company maintained it for three years at an additional charge of 4*d.* per square yard per annum. The foundation is Portland cement concrete, 12 inches thick. The annual wear of the wood is 0.154 inch, and if reduced to the standard, is equal to 0.104 inch.

Oxford Street, opposite Hereford Gardens, was originally laid on boards in November, 1874, at a cost of 16*s.* per square yard, with maintenance two years free and thirteen years 1*s.* per square yard per annum. In May, 1877 the boards were removed and new blocks laid, but they are now in a very bad condition, and are about to be taken up. Their life will have been seven years.

Henson's patent pavement has been practically tested, having been laid in Fleet Street, Oxford Street, Brompton Road, Euston Road, Uxbridge Road and elsewhere. The theoretical principles of this system, which consists of a cement-concrete foundation, plain deal blocks, on a felt bed, a close felt joint, and a dressing or grouting of boiling prepared tar, and the merits of the felt bed and joint were fully described in Mr. Howarth's Paper, and the following particulars of ascertained wear may be useful in considering its merits.

Oxford Street, Princess Street to Marylebone Lane, was laid in November, 1875, at a cost of 16*s.* 6*d.* per square yard on existing concrete. The Company offered to maintain it for fifteen years for 10*s.* per square yard, but the Marylebone Vestry arranged to do this work by their own staff. The pavement was repaired in 1879 and following years, the blocks being entirely renewed in September, 1883. Yellow-deal blocks, 5 inches deep, were originally laid, and when taken up averaged 3½ inches thick, their actual life being 7.84 years. The annual average wear of wood was therefore 0.191 inch, which, if reduced to the traffic standard already described gives 0.120 inch.

Oxford Street, Duke Street to Portman Street, was paved in October, 1876, at a cost of 14*s.* per square yard on existing concrete, the maintenance terms offered being 10*s.* per square yard for a period of twelve years. Six inch blocks were laid, and they were repaired in 1880, 1881, 1882 and 1883, their present average depth being 3.60 inches. The surface of the wood is considerably worn, but upon recently inspecting an opening in the pavement,

the foundation and joints were in an excellent condition. The probable life of the blocks is eight years. The average annual wear of the wood is equal to 0.323 inch, and as reduced to the traffic standard 0.255 inch.

Oxford Street, Hereford Gardens to Edgware Road, was paved in December, 1875, at a cost of 16*s.* 6*d.* per square yard on existing concrete. The blocks were repaired each year from 1879 to July, 1883, when they were renewed. They were originally 6 inches deep, were worn to an average depth of 3½ inches, and had a life of 7.58 years. The probable life of the existing blocks is eight years. The annual average wear of the former wood was 0.329 inch, and as reduced to the traffic standard was equal to 0.250 inch.

Brompton Road.—The eastern half was paved in December, 1878, at a cost of 12*s.* 9*d.* per square yard, with a free guarantee for three years. Since then frequent repairs have been executed by the Kensington Vestry. Six inch blocks were laid, the present average depth of which is 4.94 inches. The surface is worn in places, and is bumpy and somewhat unpleasant to drive over. It is very dirty at the joints. The probable life of the wood is six and a half years, the average annual wear being 0.184 inch or according to the traffic standard 0.236 inch.

Fleet Street.—The western half was laid in September, 1877, at a cost of 16*s.* per square yard, the maintenance charge being 17*s.* per square yard for nineteen years. It has been repaired from time to time since 1881, and is now considerably worn and uneven. The probable life of the wood is seven years. The average annual wear of the wood is 0.269 inch. which according to the traffic standard is equal to 0.173 inch.

Leadenhall Street.—In August, 1876 the eastern half was paved at a cost of 18*s.* 6*d.* per square yard, the maintenance being two years free and seventeen years at 1*s.* 6*d.* per square yard per annum. The paving has been repaired on several occasions since 1880, and parts are now in a very bad condition, the wood having quite worn through in places. The paving is to be renewed this spring, after a duration of seven and a half years; and, taking the average depth of the blocks at 4 inches, the annual wear is equal to 0.264 inch, which reduced to the traffic standard is 0.198 inch.

Euston Road, Cleveland Street to Gower Street, was paved in November, 1880, at a cost of 11*s.* 6*d.* per square yard, with three years' free and twelve years' annual maintenance at 8*d.* per square yard. The pavement is in fairly good condition, only trifling repairs having been carried out, notwithstanding that the weight of the traffic per yard width is equal to 700 tons per day.

It must be apparent to any one who has carefully noticed Henson's pavement that there is a minimum of jarring, and consequently a very steady motion in driving over it when it is in good condition; yet experience seems to prove that after a few years' wear it is not in reality cleaner or less dusty than a plain close-jointed pavement, and a reference to Table V. in the Appendix clearly shows that in durability it does not take the highest place.

The system adopted by the Asphaltic Wood Pavement Co. consists in laying a ½ inch layer of asphalt upon the concrete foundation, upon which "dipped" blocks were placed, the lower part of the joint being of asphalt and the upper of Portland cement grout. This pavement has been laid in Fleet Street and other parts of the City, The Strand, Oxford Street, High Holborn, Hatton Garden, Brompton Road, and elsewhere.

Oxford Street, Marylebone Lane to Duke Street, was laid in September, 1876 upon an existing concrete foundation, at a cost of 13*s.* 6*d.* per square yard, and offered to be maintained for fifteen years at 12*s.* per square yard. It was repaired in 1878, and each successive year to November, 1882, when the blocks were removed, and the pavement relaid upon the plain system with a cement joint. The blocks originally were 6 inches deep, and when removed had worn down to about 3 inches, their actual life being about 6.20 years. The average annual wear of wood was 0.484 inch, which, reduced to the traffic standard, is equal to 0.319 inch. The pavement suddenly broke up and went to pieces at the end of 1882, owing, it is stated, to water getting underneath, and the asphalt breaking up, which was probably caused by the "open joint" of asphalt and lime grout.

The Strand was paved in February, 1877, the cost being 13*s.* 6*d.* per square yard, and maintenance undertaken at 1*s.* per square yard for twelve years. Six inch Baltic red blocks were used, and the pavement lasted till 1882, when it was renewed. The actual life of the wood was a little over five years, but it should be observed that the daily traffic is upwards of 1,100 tons per yard width.

Fleet Street,—The eastern portion was paved in July, 1877, the cost being 15*s.* per square yard. Considerable repairs have been carried out, but it is much worn, more so than Henson's pavement, and is somewhat bumpy to drive over this may perhaps be partly accounted for by the gradient being sharp. The average annual wear of the wood is 0.456 inch, which, reduced to the traffic standard, 0.251 inch.

Regent Street.—The portion between Piccadilly Circus and Vigo Street was paved in September, 1880, at a cost of 12*s.* 6*d.* per square yard, on a cement concrete foundation, 12 inches thick, formed of 2 parts of old macadam to 1 part of ballast. 6-inch deal blocks were laid, but they already show considerable signs of wear, in fact they needed repair in 1883. The ascertained annual wear is 0.286 inch, which, reduced to the traffic standard, is equal to 0.384 inch.

Brompton Road.—The eastern part was paved in December, 1878 at a cost of 13*s.* 9*d.* per square yard. The blocks have been repaired on several occasions; the surface is in a more uneven condition than Henson's pavement, and the joints are much worn. The life of the blocks may be put at six and a half years. The ascertained annual wear is 0.373 inch, which, reduced to the traffic standard, is equal to 0.431 inch.

The author fails to observe that the asphalt bed and joint possess the merit claimed for them, and certainly the pavement in Brompton Road, the surface of which became irregular at least two years ago, is in an extremely unsatisfactory state, owing no doubt to the failure of the joint and quality of the wood.

Lloyd's patent "keyed" pavement was laid in Pall Mall in February, 1879, and, from the deplorable condition into which it had fallen in December, 1883, there can be little doubt that it has proved an utter failure. Unquestionably the work was carelessly executed, as the author found blocks varying in length from 8 inches to 15 inches, and joints from 1 inch to 2 inches in width; and when it is considered that the blocks were laid diagonally, although the wood used was pitch-pine, it is not unreasonable to attribute the failure to the mode of jointing and diagonal form of blocking. The specimen blocks submitted were taken up in December, 1883, and they reveal the fact that the so-called "key" was no key whatever, it having entirely failed to hold the blocks together; and considering the irregularity of the width of the joint and the poorness of the material with which it was formed, together with the uneven bedding of the blocks, it will be readily understood that the joints soon wore down, and that the blocks became rounded, thereby rendering the pavement uneven and more bumpy to drive over than any other modern system. The pavement originally cost 8*s.* 5*d.* per square yard only, being laid on an existing concrete foundation. When the blocks were removed they were about 4½ inches deep, but being so much rounded and unevenly worn, it was found they could not be turned and relaid; consequently deal blocks upon the plain system were subtituted. The life of a large area of the pitch-pine "keyed" blocks was therefore less than five years—an extremely unsatisfactory result, especially when it is remembered that the carriage-way is fairly wide.

The same system of pavement was laid in the upper part of Regent Street in September, 1880, at a cost of 13*s.* 9*d.* per square yard. It was repaired in 1883, and again this year; it already shows considerable wear, and is uneven in places. The blocks are of pitch-pine, 6 inches deep, and the ascertained annual wear is 0.214 inch, which, reduced to the traffic standard, is equal to 0.288 inch.

The pavement known as Carey's system was laid in Cannon Street in September, 1874, at a cost of 13*s.* 6*d.* per square yard, the maintenance terms being two years free and fifteen years at 1*s.* 6*d.* per square yard per annum. The blocks originally laid were 4 inches wide by 9 inches by 6 inches, and were shaped with alternate convex and concave ends, and laid on a thin bed of ballast, the joint being formed of lime grout. Considerable repairs and renewals have been carried out from time to time, and in March, 1884 the author saw several trenches opened near Queen Street, at which places the original blocks had worn to a depth of 3 inches, the surface being extremely uneven, not to say bad. The western section, which was renewed about a year ago, is already uneven, and begins to show signs of wear, and notwithstanding that the wood has considerable durability, yet, owing to the inferior surface of the pavement, the author would hesitate to class it among successful pavements.

The ligno-mineral pavement was laid throughout Coleman Street, City, in June 1875 at cost of 13*s.* 6*d.* per square yard. The paving consisted of mineralized pitch-pine blocks, 4 inches deep, with a "mastic" joint, the top portion being lime grout. The pavement having become worn out, owing to ope joints and decayed wood, it was taken up in April 1882, when asphalt was substituted. It is extremely probable that in consequence of the carriage-way being so much in the shade, the wood was specially liable to retain moisture. Fore Street was similarly paved in December, 1874, but the wood was replaced by asphalt in July, 1883.

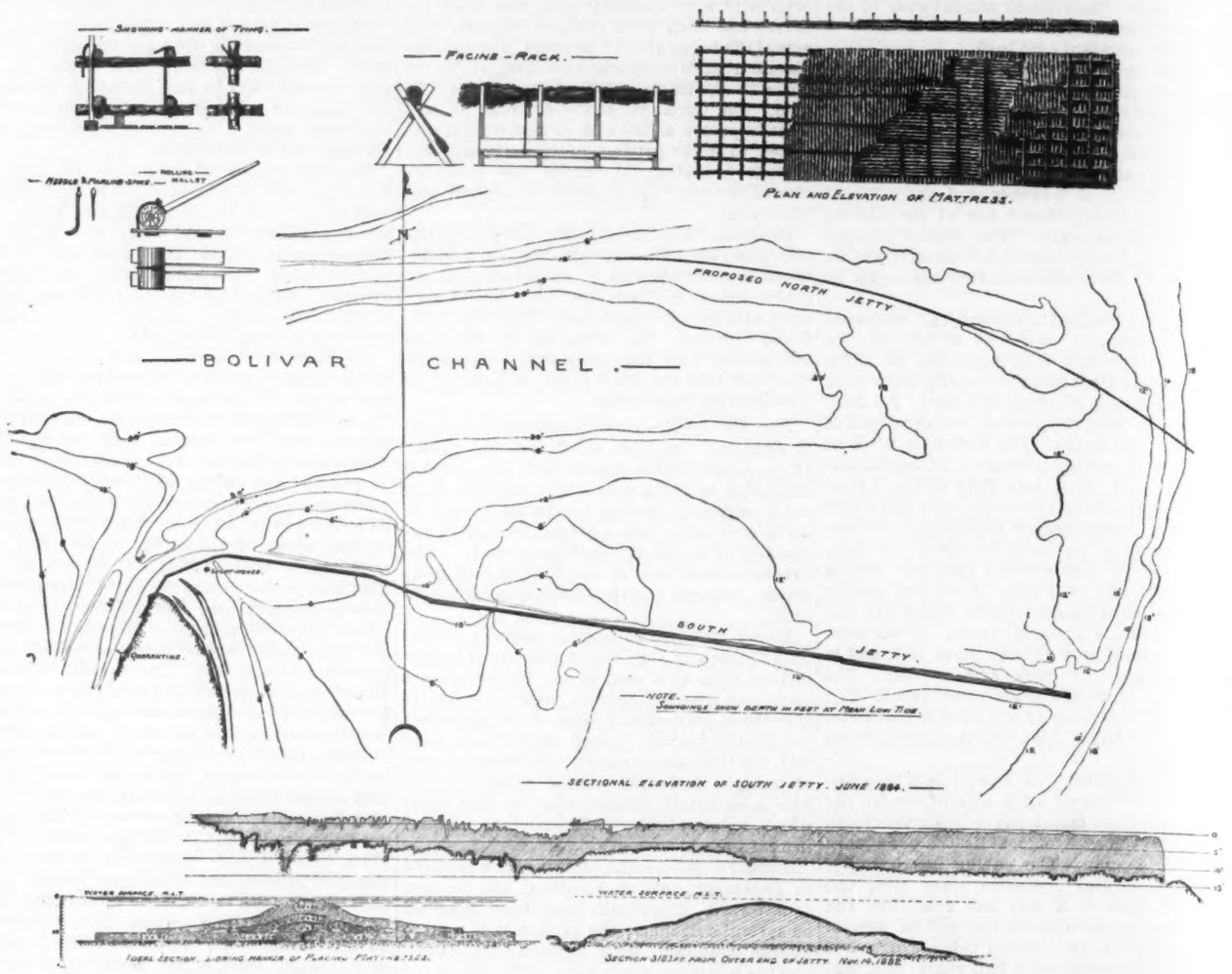
Messrs. Mowlem & Co's Pavement.—This plain system of paving has been laid in various parts of the Metropolis, particularly in the City, St. Giles, St. Marylebone, St. Pancras, and Kensington. In Princess Street, Cavendish Square, blocks which were laid in September 1874, are still in existence.

Kensington High Street.—In May, 1877, a section was laid near the Vestry Hall, at a cost of 14*s.* per square yard, with a three-years' free maintenance. 6-inch blocks were laid in their natural state, with a ½ inch joint of lime grout. The present depth of the blocks is stated to be 3 inches, the annual average wear therefore being 0.440 inch. The surface shows considerable wear, and after rain, water is retained at those points where it has worn below the channel-level. The latter evil is possibly to be attributed to the very slight rounding, 1-inch in 4 feet, to which it was laid. The blocks are to be renewed in October next, when the life of the wood will have been seven and a half years.

(TO BE CONTINUED.)

PROPOSALS will be received until December 9th, by the Department of Public Works for sewers in Fourth and Eight Avenues, and in Ninety-second, One Hundred and Fifty-sixth, and in One Hundred and Fourteenth Streets. Also until December 5th, for grading and paving in several other streets and avenues. See City Record.

THE GALVESTON HARBOR JETTY; SHOWING ALSO THE DETAILS OF MATTRESS CONSTRUCTION.



The Galveston Harbor Jetty.

The improvement to the entrance of Galveston Harbor, Texas, being a problem of great engineering interest as well as commercial importance we make the abstract, given below, from the reports of the Chief of Engineers, giving as much of the constructive details as can be obtained from this source.

Work at this point was projected in 1874, and the jetty system now under construction is from the plans, and has been built under the direct supervision, of Maj. S. M. Mansfield, U. S. Eng's, Bvt. Lieut. Col. U. S. A. After very extensive preliminary work the first mattress was actually put in place on July 13, 1880. The failure by Congress to pass the appropriation of $250,000 needed for the fiscal year 1884-85 has caused the suspension of work for the present.

The accompanying map indicates the general location of the south jetty, the only one upon which any work has yet been done, and its channel contours as shown in the survey of May—July, 1883. and also a progress profile of the jetty to the end of the working season of 1884.

The cross section of the jetty shows a series of mattresses made of brush and cane, constructed as shown in the accompanying illustration, and weighed down with stone ballast. The general system is that adopted at the mouth of the Maas, in Holland, but with some material modifications recommended by Maj. Mansfield. As at present designed the tops of the jetties are not to be raised above the level of low water, but their plan and width will permit of an increased height if it is found in the future that a sufficient depth can not otherwise be obtained.

The south jetty, as at present constructed, is about 22,551 feet long—and has a base of from 60 to 120 feet. The north jetty, not yet started, will be probably about 6000 feet distant from its neighbor at the seaward end, increasing to nearly 9000 feet nearer the shore. The plan adopted for the improvement to the entrance of Galveston Harbor, in accordance with which work has been conducted since 1880, contemplates a depth of channel across the bar of at least twenty-five (25) feet. The estimate of total cost in arriving at this result is $1,825.813, conditioned upon continuous work under annual appropriation of $500,000.

The original estimate of cost per cubic yard was $3.83; during 1882, 111,392 cubic yards of jetty were constructed at a cost of $2.88½ per yard; in 1883, 107,392 cubic yards cost $2.83 per yard, and for 1883-84, 38,204 cubic yards of jetty, including 27,906 cubic yards of brush mattress, and 10,297 cubic yards of stone ballast, cost $3.17 per cubic yard, the contingencies of office included. As this exhibit shows, the work is actually costing very considerably less than the original estimate, and this is in spite of the fact that unexpected difficulties were encountered, as shown in the reports, in securing the stone ballast in the time and quantity demanded by the economic progress of the work.

Although sufficient time has not yet elapsed to show any very marked increase in the channel depth, commerce is already benefited by an additional depth of from one to two feet in crossing the bar. An examination made in November, 1882, at an unusually low stage of water, of the crest of the completed jetty was very satisfactory. The brush work was entirely covered with stone, and the stone wel bedded, and in the older portions strongly cemented together by an accretion of shell, sea weed and moss. The worm has done no injury to the mattresses and the general stability of the work was well proven.

Letters, contained in the Report of 1883, from the Manager of the Galveston Steamship Co., and other parties interested in shipping, state that the improvement to that date was about 2 feet on the bar, which would amount to 100 tons per foot for sailing vessels, and nearly 300 tons per foot for steamers.

Though the work has dragged from lack of appropriations, and is now suspended with about one half the work finished, the experience gained, and improvement so far accomplished, are a guarantee that the finished works will produce the anticipated results. Certain it is nothing has occurred in an engineering or constructive view to lessen the confidence felt in the result.

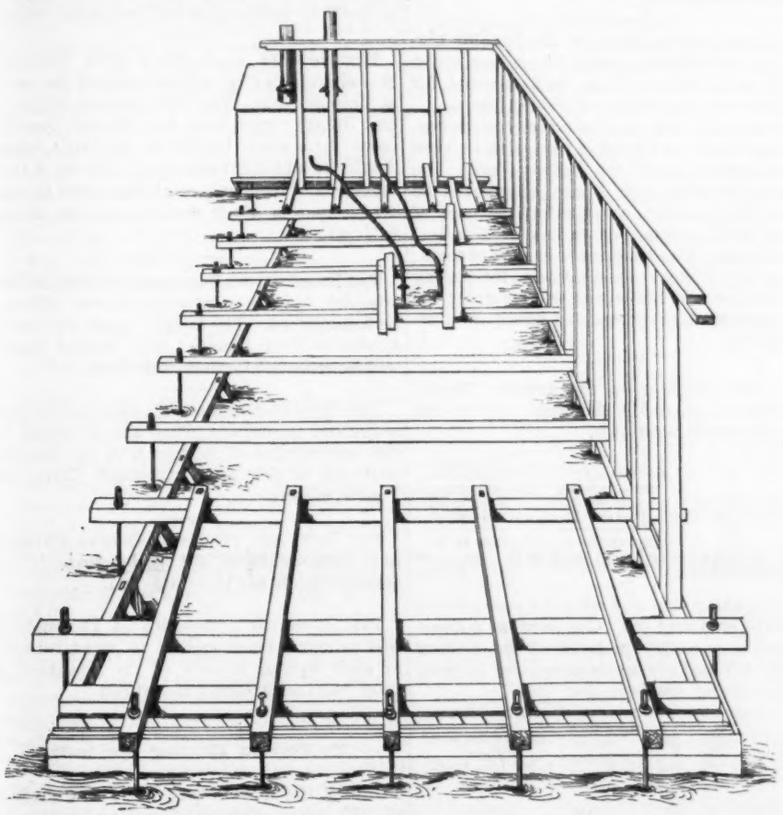
TOPEKA, KAN., November 22.—Articles of incorporation of the Independence and Verditris Railroad have been filed with the Secregary of State, providing for the construction of a standard-gauge road from Independence, Montgomery County, to Emporia, Lyon County, with a branch running from Altoona, on the main line, to Chanute, to Neosho County, and a branch from Virgil, another point on the main line, to Burlington, Coffey County. The number of miles of road to be built, including branches, is 260, for which a capital stock of $1,000,000 has been formed. The Directors are G. W. Donaldson, William Otis, A. C. Ratich, J. M. Anderson, M. H. Stahl, E. F. McFarland, P. V. Hackett, John Filkins and Henry Foster, all of Kansas. The place of business of the road will be at Independence, and the counties through which the proposed road will run are Montgomery, Wilson, Woodson, Greenwood and Lyons.

The Accident to Caisson of Pier 9 of the B. & O. R. R. Bridge, at Havre de Grace, Md.

BY E. L. ABBOTT.

In ENGINEERING NEWS of October 4th, there appeared a notice of the accident which happened at the pneumatic caisson for Pier 9, of the new bridge being built by the B & O. R. R. Co., across the Susquehanna River at Havre de Grace, Md. The Contractors for the pneumatic work are Wm. Sooy Smith, & Son. The following is a general description of the break and the manner in which it was repaired.

The caisson proper is about 18 feet high; above this are 32 feet of crib-work which was being filled with concrete; above this is a coffer-dam in which the stone masonry will be built.

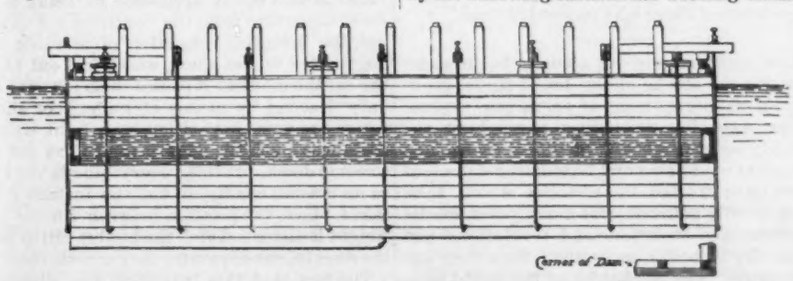


CONDITION OF DAM AFTER THE BREAK.

On the morning of October 1st, the caisson was being lowered in the usual way by allowing some of the compressed air to escape from the working chamber, thus relieving the upward pressure on the caisson. On this occasion, one side of the coffer-dam suddenly gave way with the pressure, and the water filled up the crib, throwing a great additional weight (over 2000 tons) upon the caisson, causing it to sink several feet farther, so that the working chamber became entirely filled with mud. The top of the iron shaft containing the air lock was put about 9 inches under water, and the lock itself—which was open—filled. The men who were in the working chamber, seven in number, all succeeded in getting into the shaft—where they were imprisoned—until the water could be removed from the air lock. Col. W. M. Patton, Engineer in charge, and Gen. Smith, contractor for the work, with his foremen, arrived promptly at the scene and all efforts were directed at once to the rescue of the men.

Gen. Smith acting with his usual intrepidity and presence of mind, gave directions with astonishing clearness and rapidity.

The work went on energetically but calmly and with certainty of success. All discharge pipes were immediately closed on the outside to prevent the men from letting the air out of the working chamber in order to get the air lock open, not knowing that this was submerged. The supply shaft was also closed for the same reason; though to do this an additional section had to be bolted on to it under water. Two of the discharge pipes were broken by the inflowing earth in the working chamber before they could be closed on the outside, and these had to be closed against an escaping current of air having a pressure of 27 pounds per square inch. Reducers were screwed to the end of one of the discharge pipes until it was brought down to three inches in diameter, when a three inch-valve was screwed on and closed.



B. & O. R. R. BRIDGE—SIDE OF COFFER DAM BEING REPLACED.

The other was successfully closed with a wooden plug before a full head of air began to escape, the pipe being partially closed with mud at the bottom. When this had been done the men were effectually shut into a place of safety until the remaining steps could be completed for rescuing them. *If the air lock had been at the bottom*, or if they had let off the pressure, every man of them would have been drowned.

A coffer-dam was then made by putting up boards vertically around the top of the shaft, and drawing them to it with a slip noose passing around them. A heavy tarpaulin was wrapped around the boards on the outside and the dam thus formed puddled inside with bags of Portland cement, when the water was bailed out of the lock and the men released, the compressors not having lost a single stroke. The section of coffer-dam of which one side gave way is 13 feet high 76 feet 5 inches long, and 40 feet 6 inches wide. In the accompanying "birds' eye" view the condition of the dam, after the break, is shown, the broken side pressed in several feet, the bottom much more than the top. The machinery barge is shown at the extreme end, and the water and air supply pipes which go down by the side of the air lock, which does not appear, being under water.

The other cut shows the side being rebuilt and replaced.

After removing the debris, a frame for the side was built in position in such manner that planking above, and pushing it down vertically, would bring the side into its required place.

The planking was necessarily put on under the cross tie timbers which go across the top of the dam and are held down by vertical tie rods passing through the ends. As the tide rose to these cross ties twice a day, the work could proceed only at intervals.

A thick cushion of packing had been fastened under the sill to make a tight joint when it came in contact at the bottom. The corners were caulked by a diver, and when the pumps were applied to remove the water, the dam was found to be very tight. The caisson was uninjured. Much credit is due the contractors and their foremen for the skill with which they met this accident, and prevented it from becoming a calamity, and for the dispatch, and completeness of the repairs.

Many of the pipe connections in the working chamber were broken, and the earth being packed to the roof of the chamber, required much tedious work to clear it out and put it in order. The sinking has now proceeded to rock, the surface of which being about 17 feet higher at one end of the caisson than at the other, necessitates blasting and cutting it away on the higher side in advance of the cutting edge.

This is being very successfully, and under the circumstances, rapidly done. The rock excavation will continue until the caisson can have a rock bearing over the greater portion of its surface. Then the caisson weighing ten thousand tons will be held suspended by air pressure, and friction and by blocking up from the rock until the earth is removed and the rock laid bare. Then the entire cavity will be filled with concrete.

The establishing of the five pneumatic piers of this bridge under such difficulties and in a single season ranks as one of the greatest feats of the kind ever accomplished, and adds to the already well acquired reputation of the engineers and contractors, who have planned and executed the work while it also proves beyond question the skill, energy, and fidelity of all the employés engaged upon it.

UTICA, N. Y.—The Water Company is negotiating for the purchase of land just south of the present reservoir on Golden Farm, on which to erect a new reservoir of about 500,000,000 gallons capacity. The estimated cost of the improvements is $100,000.

Engineering News

AND

AMERICAN CONTRACT JOURNAL.

Tribune Building, - - - New York City.

THE ENGINEERING NEWS PUBLISHING CO. PROPRIETOR.

PUBLISHED EVERY SATURDAY.

CONDUCTED BY

GEO. H. FROST, - - - Assoc. Am. Soc. C. E.
D. McN. STAUFFER, M.Am.Soc.C.E.: M.Inst.C.E.

TERMS OF SUBSCRIPTION:

$4.00.....PER YEAR TO U. S. AND CANADA.
$5.00..... " " " FOREIGN COUNTRIES.

CLUBBING ARRANGEMENTS.

In order to accommodate such of our subscribers as may wish to subscribe for other periodicals, we offer the following terms: We will send to any address ENGINEERING NEWS at regular subscription price, $4.00 and the following at the additional prices given:

	Net. Price.	Reg. Price.
Atlantic Monthly	$3.25	$4.00
Century Magazine	3.55	4.00
Harper's Magazine	3.25	4.00
Harper's Weekly	3.25	4.00
Harper's Young People(weekly)	2.00	1.65
Popular Science Monthly	4.25	5.00
St. Nicholas Magazine	2.55	3.00
North American Review	4.10	5.00
Puck	4.25	5.00
Blackwood's Edinburg Magazine	2.80	3.00
" with either British, Edinburg London or Westminster Reviews.	4.65	5.00
" with any two Reviews	6.50	7.00
" " three Reviews	7.90	8.50
" " the four Reviews	9.30	10.00
Any one Review (L. Scott reprint)	2.35	2.50
Any two Reviews " "	4.20	4.50
Any three Reviews " "	6.05	6.50
Any four Reviews " "	7.45	8.00
The above are the Leonard Scott Reprints.		
Frank Leslie's Chimney Corner, w	3.30	4.00
" Illustrated Newspaper, w	3.30	4.00
" Illustrirte Zeitung, w	3.30	4.00
" Popular Monthly, m	2.10	2.50
" Sunday Magazine, m	2.10	2.50
" Boys and Girls, w	1.75	2.00
" Budget of Wit, &c., m	1.75	2.00
" Pleasant Hours, m	1.30	1.50
Franklin Square Library, 52 Nos	9.00	10.00
Magazine of American History, *N. Y.*, m	4.25	5.00
Manhattan, *New York*	2.50	3.00
Wide Awake, m	2.10	2.50
Cassell's Magazine of Art, m	3.00	3.50
Cassell's Family Magazine, m	1.25	1.50
Chambers' Journal, w	2.10	2.50
" " m	2.35	2.50

PREMIUMS:

In order to stimulate *present subscribers* to increase our list, we offer the following inducements: For every new subscription sent us we will pay

ONE DOLLAR CASH.

By a little effort each subscriber can get his own subscription free at the same time that he assists in quadrupling our list.

TABLE OF CONTENTS.

	PAGE
"Wood Pavement in the Metropolis," (*Illustrated*)	253
The Galveston Harbor Jetty, (*Illustrated*)	256
The Accident to Caisson on Pier 9, of the B. & O. R.R. Bridge, at Havre de Grace, Md., (*Illustrated*).	257
Editorial Notes	258
Philadelphia Notes	258
To Prevent Elevator Accidents	258
Bricks Made of Glass Sand	259
Barrage Building by Compressed Air	259
The Hardening of Cement	259
Personal	259
Literature	259
Track (*Illustrated*)	260
Irrigation Progress in Eastern Montana	260
Examination of Local Surveyors and Inspectors of Nuisances	261
A Year's Railway Working	261
Ordnance for Harbor Defence	262
Water	262
News of Week	263 264

Make all drafts, cheques and money orders payable to **Engineering News Publishing Co.**

THE Daft Electric Company are said to have obtained permission to experiment with their motor on the East River Bridge, provided that they meet all the expenses and only try their cars when the regular bridge trains are not running.

A BUSINESS MEN'S meeting, of the City of Philadelphia, warmly applauded the energy and ability of Col. Wm. Ludlow as Chief of the Water Department, and lately recommended an increase of his salary from $6,000 to $10,000. Councils so far have declined to make the suggested raise.

THE "Menocal" Nicaragua Canal contract has been abrogated, according to the *Official Gazette* of Nicaragua. The concession made to the Provisional Company of New York, originally granted for 2 years on April 24, 1880, was extended for another 2 years on Feb. 22, 1882. The company having failed to conclude definite plans and organize in proper form, the concession is now null and void and has been officially so declared.

M. EIFFEL, the engineer of the Garabit Viaduct, has presented a design for an iron tower 1,000 ft., or 300 metres, high, to be erected for the Universal Exposition of 1889, at Paris.

It is provided with an observatory at the top, and four elevators for those who wish to view the panorama spread out before them. The designer suggests that it can afterwards be utilized for stragetic observations in case of war, as it will command a radius of 37 miles; for communication by signals in case of siege; for meteorological observations, for testing the direction and violence of wind storms; for astronomical observations and finally for electric lighting.

IN a late article upon the Arlberg Tunnel by a French engineer, the final cost of the tunnel is stated as follows:

	Cost of tunnel proper	Provisional plant before final adjustment.
West side (Langen)	13,718,000 fr.	1,548,000 fr.
East side (St. Antoine)	12,424,000 fr.	1,544,000 fr.
	27,142,000 fr.	3,093,000 fr.
Total cost of tunnel (33,685 fr.)	30,235,000 fr.	= $6,047,000
Cost per lineal foot		$179.54

In comparing this cost with the expenditure at Mont-Cenis and St. Gotthard a notable economy is remarked in favor of the Arlberg Tunnel; in point of time required the Arlberg also exceeds its predecessors.

Tunnels.	Length Miles.	Time Months	Both Ends. Daily Advance 24 hours.	Cost of Finished Tunnel. per Lin. Foot.
Mont-Cenis	7.44	157	7.7 feet	$375.61
Gotthard	9.3	88	18.04 "	237.80
Arlberg	6.2	10	27.22 "	179.54

The above figures point out in a marked manner both the advance in the art of tunnel-driving since 1871, the year in which the Mont-Cenis was finished, and the degree to which the engineers of the Arlberg profited by the experience of those who preceeded them.

Low wages are not due alone to business depression but also to cheap bread-stuffs, growing out of the expansion of our railway system. These sweeping reductions throughout the country point to a better condition as soon as the great equalizing and liquidating forces at work have exerted the energies which have been quietly gathering for many years. Social problems and evolutions and revolutions will some day be better understood than they are at present. The mechanics of the world have done their party in placing men and powerful agencies at the service of man. It now remains for the thinkers, the philosophers of the world, the social economists, to point out how the enormous productive capacity and the enormous labor energy can be steadily employed. The supply of all kinds of merchandise has been restricted to within the limits of average demand. This is the turning point. For nearly a year past manufacturers have reused to curb production to the extent which the market seemed to require, but latterly they have done so. The iron trade is extremely dull. Rail makers are busy in Eastern mills, carpet, cotton, woolen and hosiery mills, are turning out smaller quantities of goods than they have turned out for years; stocks of goods are being depleted. The prospects just at this hour are not particularly pleasing, but the right conditions are working, and an improving trade is the logical outcome.

Philadelphia Notes.

A defective casting caused the bursting of a 30-inch main at the Spring Garden Station, Philadelphia, on Thursday Nov. 20. One of the new Worthington engines, with a capacity of 15,000,000 gallons per day, was being tested.

THE eleventh anniversary of St. Timothy's Workingmen's Club was celebrated last week at Philadelphia. The club has a reading room and library; pays sick and funeral benefits: has a room where bagatelle, billiards, chess, dominoes and other games are played. A technical school has been established and lectures are delivered. Such trades-unionism as this will tell.

THE Broad Street Passenger Station, at Philadelphia, is to be enlarged, and work will soon be commenced. The freight track will be extended to Penn Square. The freight station will be removed further westward.

THE Chief Engineer of Philadelphia has been requested to prepare plans and estimates for the construction of bridges over the Reading Railroad in that city, at Second, Third, and Fourth Streets.

THE lines and grades of several Philadelphia thoroughfares are to be revised, and several streets are to be widened.

THE street car companies of Philadelphia will probably be requested to make turnouts in each square, in view of the possibility of snow blockades during the winter.

To Prevent Elevator Accidents.

One of the most severe trials ever made to test the safety of elevators was undertaken by Mr. John Hodges, on the 20th inst., at a house on Madison Avenue and 51st Street, belonging to Mr. E. D. Adams of the firm of Winslow, Lanier & Co. The car was allowed to fall *one hundred and one times*, and not the least injury resulted therefrom to either the occupant or the elevator, Mr. Hodges riding therein at every trial. On a former occasion we have alluded to this safety appliance as being a decided departure from the contrivances now in use, the invention consisting of movable iron dogs a few inches apart, which fall out under the car the moment it passes them; the car can only descend by means of buffers, or shoes, which are kept in position by a light weight, and these push the dogs in and allow the car to come down, provided everything is working in its normal condition, but the instant a fall takes place, the relation between the car and weight is disturbed and, the buffers fail to push the dogs in, consequently the car rests thereon.

The fact that this invention has withstood such extraordinary tests—it having been tried 78 consecutive times at Messrs. Millers' factory, 349 West 26th Street a few months ago—justifies the good opinion we entertained for it, and we predict for the inventor a general introduction of his safety appliance as its simplicity and certainty must soon commend itself to the public. Mr. Hodges has an office in the Mills Building, where further information concerning this valuable invention can be obtained.

Bricks made of Glass Sand.

Bricks are now being made in Marpent, France, which can be advantageously employed in decoration and in replacing material in construction failing from the effects of time and temperature.

These bricks are of a uniform white color, and are made from sand similar to that used in the manufacture of glass, or from a chemical point of view, an almost pure silica. The sand is first compressed by hydraulic power with pressures ranging from 600 to 800 kilogrammes per square centimetre of surface (8,500 to 11,300 lbs. per square inch). The bricks obtained are then burned at a temperature of 1,500° C.

Experiments made show that these bricks have a crushing strength of from 384 to 450 kilogrammes per square centimetre (5,453 to 6,390 lbs. per square inch); and that the strength is practically the same whether the bricks are tested dry, or after 15 or 40 days immersion in water. This shows that they are safe from the effect of rain. Extreme cold and very high temperatures have likewise left them intact. Their density in a dry state is 1,500, and they will absorb in weight 25% of water.

The price of bricks, 220 × 110 × 55 millimetres, is 75 francs per thousand at the works, or 100 francs per thousand delivered in Paris.

Annales des Travaux Publics.

Barrage Building by Compressed Air.

According to the *Annales des Ponts et Chausseès* compressed-air has been very successfully used in laying the foundation masonry of the *barrages*, or moveable dams, of Coudray and d'Evry, in France. The plan adopted was somewhat similar to that employed in constructing the Antwerp Docks; the caisson being built of plate iron, and suspended by screws from a timber frame resting upon piles. The caisson was 20 *m* (65.6 ft.) long, by 7.8 *m*, (25.5 ft.) wide and 6.08 *m* (22.9 ft.) high; the working chamber was 8½ ft. high in the clear. In form it was rectangular with vertical sides formed of T iron and plate; the roof was made by fourteen transverse plate girders, each 3 ft. deep, with an iron skin above and below, and the intervening space filled with sand; the further counter-weighting was obtained by using pigs of iron. There were three air-locks, of ordinary construction, the central one large enough to pass stone etc., 4 × 2 × 1½ ft. into the working chamber. The weight of the caisson, not including the air-locks, was 1,804,000 lbs. and including all appliances, 2,640,000 lbs.

When first used the air escaped at the numerous joints in the iron-work of the caisson, but though this was overcome at first by an application of clay, Serbat cement was finally applied.

In connection with this article, is a reference to the friction on the sides of the caisson in sinking as determined in practice by M. Montaguier; the gentlemen quoted found that in sinking a distance of 10 ft. into fine sand the frictional resistance was 103 kilogrammes per square metre of surface exposed to the sand (21.01 lbs. per sq. ft.,) and in gravel it was 208 kilogrammes, (42.4 lbs. per sq. ft.) This was connected with the use of compressed air, and the consequent presence of a film of escaping air between the sides of the caisson and the material penetrated.

In the case of the Coudray barrage, 20 screws with a total power of 300 tons were used in lifting the caisson as the masonry was built, and this operation was assisted by a number of 15 ton screw jacks acting between the masonry and the roof of the working chamber. In this barrage the distance from base of masonry to the surface of water was about 18½ ft.

ENGINEERING NEWS Three months for One Dollar.

The Hardening of Cements.

M. de Perrodil, Engineer-in-Chief of Bridges and Roads, has lately been making some interesting experiments upon the hardening quality of cements.

These investigations were based upon Portland cement, made by Longuetty & Co., which presented upon analysis the following component parts, i. e. after the complete expulsion of water and carbonic acid:

Silica	23.8
Grains of Quartz	1.3
Alumina	8.9
Peroxyde of Iron	2.0
Lime	63.6
Magnesia	0.4
	100.0

An equal number of small cubes of like dimensions were experimented upon, some exposed to the air and others submerged in water. At different periods four blocks from each class were tested for their crushing strength. The debris was analysed with a view to determine the amount of water of combination and the carbonic acid. The result of these experiments convinced him that the resistance to crushing increased with the amount of water combined; in other words, the strength of the cement mortar was greater when immersed in water than when exposed to the air only.

Le Génie Civil

PERSONAL.

MR. JOHN A. GRANT has tendered his resignation as Chief Engineer of the Louisville, New Orleans & Texas Railroad, to take effect December 1.

W. H. BARNES, late General Superintendent of the Boston & Albany R. R. Co., was promoted, on Nov. 20, to the position of General Manager of that road.

THOMAS JACKSON has been promoted from Division Engineer, Western Division Penna. Company to Roadmaster of same division, with head-quarters at Fort Wayne, Ind.. To take effect December, 1.

HENRY HOWARD, a well-known architect, died at New Orleans, La., on the 25th inst., of paralysis, aged 68 years. The *States* says he was beyond all doubt the greatest architect that city has ever known.

MAJOR CHARLES W. RAYMOND, Corps of Engineers, in addition to his present duties, is ordered to report by letter to the Secretary of the Treasury for temporary duty as Engineer Officer of the first and second Light-house districts.

ROBERT GARRETT was elected President of the B. & O. R. R. Co., on Nov. 20. At the same time, SAMUEL SPENCER was elected Vice President, THOMAS M. KING, 2nd. Vice President, BRADFORD DUNNING, General Manager, and WM. M. CLEMENTS, General Superintendent. A resolution making the President's salary $25,000 was rescinded by the action of MR. GARRETT, who requested his salary to remain the same as when Vice President.

ISAAC S. BUCKELEW, late Superintendent of the Amboy Division of the Pennsylvania Railroad, died in Camden, N. J., on November 25th. MR. BUCKELEW was born at Jamesburg, N. J., in 1829; was educated at Rutger's College and embraced the profession of a civil engineer. He was Superintendent of the Jamesburg and Freehold Railroad., and in 1873 when the Pennsylvania Railroad Company leased the United Railways of New Jersey, MR. BUCKELEW was made Superintendent of the Camden and Amboy Railroad.

DANIEL L. WELLS, of Milwaukee, Wis., died at his late residence, No. 78 Prospect-Avenue, in that city, on Nov. 24.

MR. WELLS was born in Middlebury, Vt., July, 22, 1821, was engaged in railroad construction all his life, beginning in 1849 with T. T. Strong, the contractor for building the Eastern Division of the Rutland and Burlington Railroad. He was also interested in the building of the Rutland and Washington Railroad and some Canadian roads. Thence he went to Cincinnati, Ohio, where he did work on the Ohio and Mississippi Railroad. In 1856 he became associated with Selah Chamberlain in constructing the old La Crosse and Milwaukee Railroad from Minnesota Junction to La Crosse. In 1859 the firm of Wells & French constructed the Chicago and North-western Railway from Janesville to Fort Howard. The firm was steadily engaged in railroad construction in the States of Illinois, Wisconsin, Minnesota, Iowa, Missouri, Kansas, and Michigan until 1880, when, by the death of Mr. French, the firm was dissolved. Messrs. Wells, Harrison & Shute, and on the death of Mr. Shute, Messrs. Wells, Harrison & Greene have continued an active career as railroad contractors and builders. About 1862 Mr. Wells became the junior partner of the firm of Chapin & Wells, bridge and car builders of Chicago. Mr. Chapin, having disposed of his interest to Wells & French, the firm was succeeded by the Wells & French Manufacturing Company, which became, and still is, one of the largest bridge and car building concerns in the West. He retired from active business about five years ago.

LITERATURE.

Stationary Steam Engines; especially as adapted to Electric Lighting purposes. By ROBERT H. THURSTON, A. M., C.E., Professor of Engineering at the Stevens Institute of Technology etc. New York. JOHN WILEY & SON, Publisher.—Price $2.00

The above is a reprint of a series of articles written for the *Electrician and Electrical Engineer*, and is a clear and concise account of the adaptation of the steam engine to modern industries and especially to electric lighting. The work is very fully illustrated and describes the latest steam engines of the directly and indirectly connected and fast-running types.

Transactions and Proceedings of the American Society of Civil Engineers. October 1883.

CONTENTS:—The South Pass Jetties.—Ten years Practical Teachings in River and Harbor Hydraulics:—E. L. Corthell. Levee Theory tested by Facts;—Robert E. McMath.

GEORGIA'S FINANCES.—In his message to the Legislature of Georgia, Governor McDaniel gives an encouraging account of the progres, of Georgia during the past year in general prosperity. The number of new manufacturing enterprises which were created during the past year added much to the wealth of the state. The general depression existing throughout the country had a bad effect upon the industries of the state. but no disastrous failure was reported from any part of the state. The total bonded debt of the state on October 1, 1882, was $9,624,135. At the corresponding period of 1883, it was $9,454,635 and on October 31, 1884, it had decreased to $8,704,635, showing a reduction of $169,500 in 1883 and of $750,000 in 1884. By reason of too low a rate of taxation in 1883 the State was forced to incur a debt of $160,000, and while really in a sound and prosperous condition was forced to run in debt to pay the ordinary running expenses of the government. The large amount of the public debt falling due in the next five years, amounting to nearly $8,000,000, makes some new arrangement for rebonding the debt necessary. Governor McDaniel suggests that the debt be rebonded in bonds maturing in not less than thirty years and drawing not more than 5 per cent. interest. With the excellent credit which the state of Georgia commands this arrangement should be extremely easy of accomplishment.—*Bradstreets.*

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page 248.*)

In Europe a large portion of the track is laid on longitudinal stringers instead of cross-ties a method formerly considered the best but latterly being superseded by the cross-tie system. Their cross-ties are rarely of plain wood, but generally treated by some chemical preservative process or else made of stone, iron or steel. This last material is receiving considerable attention, especially in Germany. The rails are fastened to the metal ties by various combinations of clamps, bolts or rivets. With high prices for wood abroad and diminishing cost of steel, it is probably the material of the near future.

Fig. 26 gives cross-section and plan of the metal tie of the Bergisch-Markisch Railway of Germany, together with details of joint and fastening. After a long series of experiments extending over many years, they finally arrived at the design as shown. The ends and sides of the ties are turned down to more completely hold the ballast, as at first this latter was found to have a tendency to work out. The ties are made of a mild steel, capable of standing tension tests of 64,000 lbs. per square inch with 15 per cent., of elongation, and weigh 99 lbs. each with a length of 7½ feet. In Germany they are worth $1.53 each, with metal at $34 per ton, while a creosoted wooden tie costs $1.40 to $1.50. The result of eight years experience with this form show that except in wet tunnels rusting does not take place; that there is slight wear under the rail due to vibration caused by poor fastenings, a defect they claim to have remedied by the improved design as shown in the figure and by making them out of toughened iron; that breakage is slight being only 172 out of 273900; that the increased cost is more than compensated by the increased durability; that they are safer; that the expense of laying and taking up are about the same as for wood. They recommend that the tie in design should be as simple as possible so that it can be entirely made by machine. (This is the English cross metalic cross-tie.)

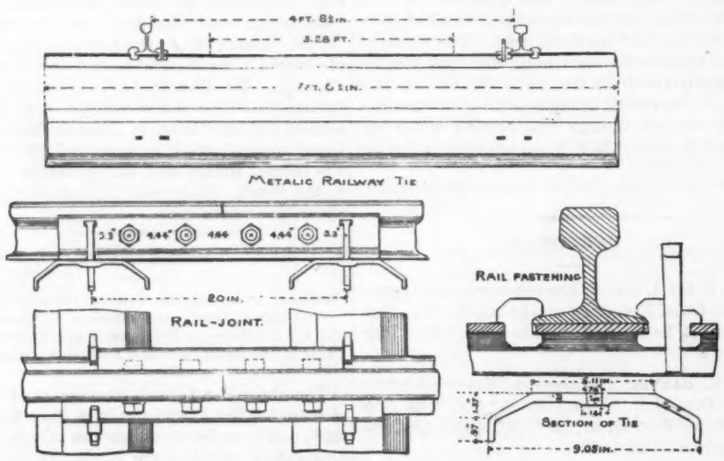


FIG. 26—METAL TIE, BERGISCH MARKISCH RAILWAY.

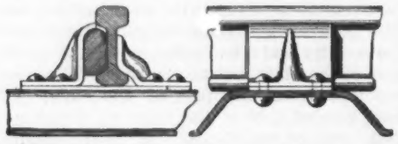


FIG. 27—METAL TIE, LONDON AND NORTHWESTERN RAILWAY.

As a sample of English practice there is shown in Fig. 27 cross-section and details of chair of Webb's steel-rolled tie as used on the London and Northwestern, the weight of the tie is 174 lbs. and length 9 ft.

Between chair and tie is inserted a steel lining plate and sheets of brown paper soaked in tar to overcome tendency to get loose and clatter. The chairs are of steel stamped out by a steam hammer. The key is wood which it is said does not get loose. A slight cant is given to the rail by the chair being set at an angle to fit the coming of the wheels, the same effect being obtained in the German tie by giving the whole a deflection. These ties of Mr. Webb, after use of over three years give satisfaction, but require, as do all metal ties, that drainage shall be perfect.

In this country, although the steel age may be yet in the future, still on account of the large and increasing amount of timber used annually in cross ties, with consequent rise in price, the prolongation of the life of the tie is already a question to be seriously considered. As entering into this problem, investigations are being made looking towards the hardening and preservation from decay of our less valuable woods, as hemlock, in the hope that by some process they may be made to take the place of the more valuable and scarcer oak.

Among the principal methods of preserving are the following:

Kyanizing.—The timber is saturated either by long immersion or great pressure with a solution consisting of 1 lb. of chloride of mercury and 4 gals. of water.

Burnettising or "Zinc Process".—A solution consisting of 1 lb. chloride of zinc to 10 gals. of water is forced into the wood with a pressure of 150 lbs. to the square inch.

Boucherie's Process.—A solution of sulphate or pyrolignite of copper is forced through the stick.

Seeley's Process or "Creosote".—Consists in treating the timber with dead oil.

Bethel's Process.—Is similar to Seeley's.

The general theory of all these processes is that moisture, the decaying agent, is expelled and the wood cells filled instead with a mixture which resists deterioation of the fibres by keeping them free from the destructive causes.

(TO BE CONTINUED.)

* Copyright by ENGINEERING NEWS PUBLISHING CO. All Rights Reserved. This article was commenced on October 4, 1884.

MR. FRANCIS LATHROP, whose fame as a decorative painter is well known in connection with the Metropolitan Opera House, and other public and private buildings, has made a handsome and striking design for the cover of *Cassell's Family Magazine*. The new cover will appear on the first number of the new volume for January, 1885, and will be ready December 12th, 1884.

Irrigation Progress in Eastern Montana.

All the Rocky Mountain Valley regions partake, in a large degree, of the dry alkaline prairie so well portrayed in Mormon Utah. The soils are alluvial, sometimes a wash from the sedimentary strata of cretaceous seas, frequently from mountain sources, and occasionally the lacustrine deposits of the Miocene.

The waters are directly or indirectly derived from the melting snows in mountain gorges and on peaks. The soils are highly charged with chemical and mineral properties, such as: soda, potash, lime, phosphates, silica and alumina, which supply the germ conditions for an agricultural soil.

Rains seldom occur except in spring. The ground is generally covered with a sparse growth of buffalo and bunch grass, which is exceedingly nutritious; below the surface it has a compressed, baked appearance, indicating ages since it has received the moistening influence of water. As in the valley of the Nile, inundation, natural or artificial, is absolutely essential to cultivation.

In Utah, the alkaline, sage brush desert yields its bounteous harvest of grain and fruit, under the patient hand of the deluded Mormon; the secret of the mysterious transformation is found in the mountain streams which he has coaxed through winding ditches to moisten the parched surface. The same is true in California, Colorado and Arizona; the consequent result are large and long ditches or canals under the most careful management.

Montana, being further north is favored with a trifle more moisture, and has much land under a natural overflow, for irrigation. With the advent of railroads and a greater agricultural population, an extensive system of artificial irrigation is necessary.

Small ditches in Eastern Montana date back to 1876, or even earlier. At this date, near Fort Benton, Highwood Belt and Schonkin Creeks, a thrifty population, is supported tilling the soil watered from these babbling trout streams; near Sun River some ditches had been built; west of Bozeman, on the Gallatin and upper Missouri valley, a similar condition existed, and large crops, 40 bushels of wheat and 60 bushels of oats, were the rewards of industry.

During the summer of 1878 in the Sioux Indian country and Yellowstone valley, near a trading post called Coulson, a ditch was constructed by the Hon. P. W. Meadow, 3 miles long 6 feet deep and 10 feet wide. The grade for this was laid with a common spirit level and triangle, by Jim Westbrook, undoubtedly the first attempt to turn this famous stream of Lewis & Clarke from its natural bed. With this initial, fourteen more followed in the locality of Billings, among them being the "Big Ditch" running 38 miles through the Clarks Fork Bottom. The company was incorporated March 15, 1882, as the Minnesota and Montana Land & Improvement Co., with a capital of $200,000. H. Clark, President, Geo. B. Huelm, Secretary, and W. H. W. Rowley, Engineer. Oliver Billings was an active Director. The survey was completed May 1, 1882, and work commenced immediately under the contract system. This ditch has a 35 foot bottom, is 4 feet deep, slopes 1 to 1, fall 2.64 feet per miles, 38 miles in length and has a head gate for a rise of 15 feet in the Yellowstone River from which the water is diverted. It was finished during the fall of 1883, and used for irrigation during the seasons of 1883-84. Total cost was $100,000.

There are 75,000 acres of productive alluvial soil, below the level of this ditch. This soil has proven itself capable of producing a varied and large yield of cereals, vegetables and fruits, when under cultivation with water. The ditch lies 150 feet above the town of Billings, and furnishes five water powers of 10 and 20 feet fall. This canal has already added to the prosperity of the town of Billings, the capital

of the Yellowstone country, which, with the benefit of irrigation, cannot fail to become within a short time, in addition to its present commercial standing, an important agricultural centre.

The Co-operative Ditch Co. of this Valley was incorporated in May of the present year with Sid. Irwin, President, Paul Van Cleve, Secretary, and J. C. Isaaci, Engineer. A location immediately followed. Construction is on the economical plan of combined effort. The gates and flumes are arranged for a 20 foot bottom, while the temporary excavation is for a ten foot ditch; slopes 1½ to 1; three feet deep; fall 2.64 feet per mile and 18 miles in length. The work is well advanced. This ditch will water much land already producing crops. The flumes on this ditch, of which there are three, are built with wooden bands, arranged to tighten by wedges working in the mortise and tenon at the corners of the flume box; no nails are used. The cracks are caulked by strips of gunny sacks with the edges spread on top, which prevent the accumulation of gravel, etc.; in addition to board wings leakage at the ends is provided for by gunny sacks filled with sand; this becomes necessary on account of a tendency on the part of all alkaline soils to melt away when saturated with water. As this ditch was taken from a slough of the Yellowstone a dam was built on the segment of a circle. At Miles City, also in the valley of the Yellowstone, a ditch is being built by the Tongue River Irrigating and Ditch Co., which was incorporated July 19th, 1882, with Jas. A Brisbin, Major U.S. Army, as President, Jas. Leighton, Vice President, A. C. Girard, Secretary, and A. L. Edwards, Engineer. Work commenced Aug. 16th, 1882 and has been in slow progress ever since with 14 miles completed to date. There are 14 miles more to complete, which will place 30,000 acres of land below the ditch. This ditch is 5 feet deep, has a fall of 2.64 feet per mile, and in addition to irrigation will supply Miles City with water through a storage reservoir, with a capacity of 100,000 gallons. A dam was thrown across Tongue River, from which the supply is obtained, 600 feet in length with a breast 6 feet high. The ditch is being completed under the engineering direction of E. M. Snyder. At Bozeman a survey was made during the spring of 1883 by Samuel Burdock for a ditch 22 miles long, 24 foot bottom: slopes 1 to 1 and 4 foot head of water. Walter Cooper was one of the prime movers. This ditch has some heavy cutting at its head, 600 feet is in cribbing in taking the water from the West Gallatin River, and is in an advanced state of progress. Some parts will have a fall of four feet to the mile, and when finished 100,000 acres of the noted West Gallatin Valley will be below the ditch. The company is duly incorporated. A survey is just completed for (40) forty miles of ditch on the Big Horn River, made under the auspices of the Indian Department of the U. S. Government for the benefit of the Crow Indians. The Sun River Canal Co., a local corporation was organized at Helena with Mr. J. D. McIntyre, Chief Engineer and Superintendent. A survey has been made to the high prairie for a ditch with 15 foot bottom to carry 5 feet of water: slopes to 1 and "grade" 2.64 feet per mile. The water will be taken from the Teton River and can be carried for fifty miles, which would place 400,000 acres below the ditch.

A canal is projected, to be taken from the Yellowstone River, below Billings, to water that vast area lying between the latter stream and the Musselishell River. It is to have a 75 foot bottom and will be 100 miles in length with a possible extension of another 100 miles. At least 2,000,000 acres of very productive land will come under its congenial influence besides tapping a very extensive coal field.

All of the above are in the water shed of the upper Missouri River.

This resumé, incomplete as it necessarily is, will demonstrate most conclusively that Eastern Montana has been, and is still, alive to the importance of irrigation on a large scale; that it is a success, was proven years ago.

The extension of ditches is dependent on the advent of agriculturists and capital.

J. C. ISAACI, C. E.

BILLINGS, MONTANA
NOVEMBER 13TH, 1884.

Engineering News, Sept. 20th, 1884.

Examination of Local Surveyors and Inspectors of Nuisances.

At an examination held by the Sanitary Institute of Great Britain, November 6th and 7th, twenty-seven candidates presented themselves as local surveyors, and nineteen as inspectors of nuisances. The Institute's certificate of competency to discharge the duties of local surveyors was awarded to B. R. Phillipson, J. Eworth, and Gilbert Thomson; and to discharge the duties of inspectors of nuisances, to W. Daley, J. Brooks, J. Houghton, J. Keal, T. Wheat, W. Fraser, J. Loach, J. M. Marshall, F. S. Winser, J. T. Simpson, A. H. Rollinson, and Ben Potter. The following are the examination papers:—

LOCAL SURVEYORS.

Paper I.

1. On what subjects, and under what conditions and restrictions, may by-laws be made under the Public Health Act, 1875—(*a*) By Urban Sanitary Authorities? (*b*) By Rural Sanitary Authorities?

2. What are the powers and obligations of Urban and Rural Sanitary Authorities with respect to water supply within the area of their several districts?

3. What volume of sewage would you provide for at the outfall sewer from a town of 10,000 population, the drainage area being 550 acres, taking 25 gallons per head of water supply and ½ in. rainfall in 24 hours?

4. Give a specification and make a sketch of a water-tight sewer. Describe and give a sketch of the form of manhole which you consider best adapted for ordinary town sewers; and state the rule which you adopt for determining the amount of ventilation to be afforded in the main street sewer.

5. In what way does the size and shape of a sewer affect the velocity of the sewage flowing through it? If a 12 in. pipe sewer with an inclination of 1 in 175 gives a velocity of 3½ ft. per second, what velocity would it give if laid at an inclination of 1 in 500 (the pipe running half full in each case), and would this latter velocity suffice to keep the sewer clear of deposit? To what extent could this velocity be practically increased by flushing?

6. Describe in detail what precautions should be taken in connecting houses with sewers, in order to prevent the foul gases from the sewers entering the houses. Illustrate your answer by a sketch.

Paper II.

7. In providing a water supply for a town what are the chief points to which you would direct attention if the supply is to be derived —(*a*) From wells? (*b*) From streams?

8. What is meant by "constant" and by "intermittent" water supply? Explain the advantages of each? Can a constant supply of of water became polluted inside a house where there are no cisterns, and if so in what way? What precautions are necessary to be taken to prevent water being polluted inside a house?

9. Describe the construction of an ordinary rain gauge and the precautions which should be taken in fixing it. Give instances of the amount of annual rainfall in various places. What weight of water does one inch on an acre represent?

10. Make a figured sketch of the main front and back walls of a house of four stories, including basement, showing the upper minimum heights of the rooms and the thickness of the walls.

11. What are the most important points to be considered in examining the ventilation of a room? How much cubic space would you require per head—(*a*) In sleeping rooms? (*b*) In rooms used for living and sleeping.?

12. Make a sketch and describe in detail the construction of a first-class macadamized road with foot-paths.

INSPECTORS OF NUISANCES.

1. What powers are lodged in local authorities with respect to the prevention of infectious and epidemic disease?

2. What are the provisions of the Public Health Act with regard to cellar dwellings?

3. Describe some efficient and simple means of ventilating sleeping rooms? What do you consider overcrowding?

4. In inspecting premises, to what points would you direct your attention to ascertain whether the water supply in wholsome?—(*a*) In the case of a water supply derived from wells? (*b*) In the case of the water being supplied from a town main into a cistern?

5. How should the soil pipes, sink pipes, and overflow pipes of a dwelling be dealt with, so as to prevent any danger to the inmates? What do you consider a proper fall for a 6 in. house drain, and how should it be connected with the public sewer?

6. Describe a bell trap, a D trap, and a pan water closet. State the objections to each, and illustrate your answer by sketches.

7. What are the characteristics of good meat? How do you recognize unwholesome meat and fish, and what are the powers under which they can be seized and condemned?

8. In the inspection of a slaughter house to what points would you particularly attend?

A Year's Railway Working.

An analysis of the elaborate return, just issued by the Board of Trade giving the results of a year's working of the railways of the United Kingdom shows that there are 18,681 miles of railway open in England, Scotland, and Ireland. The number of miles run by passenger trains in twelve months ending December last was 138,176,940, while mineral trains ran 127,983,263 miles; mixed trains, 2,737,043 miles, making a grand total of 268,897,236 miles run. To accomplish this enormous mileage, there are in use 14,469 locomotives, 32,304 carriages for passengers, and 458,357 vans, wagons, and vehicles besides a very large number of wagons and vehicles owned by private individuals and by other than railway corporations. As regards traffic, the returns show, in regard to passengers, there were 36,387,877 first-class bookings, in £3,670,053; 66,096,784 second-class bookings, earning £3,329,744; and 581,233,476 third-class bookings, adding £17,050,054 to the revenue. In addition to this there were 632,050 season tickets issued, yielding £1,692,591, while excess luggage and mails, earned £3,766,281, bringing up the total receipts from passenger trains to £29,508,733 As to goods and mineral traffic, the returns show that 189,485,612 tons of minerals were carried, and 76,897,356 tons of goods and merchandise. The total receipts from minerals and goods amounted to £38,701,319, and from miscellaneous sources to £2,852,218, making, with the £29,508,733 received from passenger traffic, a grand total earned of £71,062,270 from all sources in the twelve months. From this has to be deducted the working expenses, which amount to a total of £37,368,562, leaving a balance of profit amounting to £33,693,708. The average cost of working during the year 1883 amounted to a little over 2s. 8d. per train mile. The receipts per train mile were over 5s.0¾d. (the exact sum being 60.88d.,) leaving a clear profit of nearly 2s. 4¾d. (28.71d.) upon every mile run, The proportion of expenditure to receipts was therefore 53 per cent. The total capital paid up and raised by loans and debenture stocks amounts to £784,921,312. As regards ordinary capital the rate of dividend is very nearly the highest average paid for ten years, as, if the interest were equally divided, it would suffice to pay an average of £4.68 per cent. upon the whole of the ordinary capital. About 70 per cent. of the capital receives dividends ranging from 3 to 5 per cent.; £74,928,678 of capital receives dividends of between 3 and 4 per cent.; and £73,927,160 receives dividend between 4 and 5 per cent., while £165,000 of stock pays no less than 17 per cent., which is the highest point. The capital of constructed lines upon which no dividend is paid amounts to £8,817,918.—*Contract Journal.*

MENOMINEE, Mich.—H. F. Dunham, of the firm of Dunham & Paine, civil engineers, Cleveland, O,, has the contract for constructing the water-works. The Lake Shore Iron Foundry, of Cleveland, has the contract for furnishing eight miles of pipe.

Ordnance for Harbor Defence.

The report of the Armament Board appointed in pursuance of an act of Congress to make certain tests of artillery, has been made to the Secretary of War. The Board interpreted the act of Congress under which it was appointed to refer only to mortars and guns of high power for the defence of harbors, and did not take into consideration the lighter guns required for the flank defence of permanent works. The Board first directed its attention to the depth of water in the channels leading to all of the seaports, and then ascertained the number of, and thickness of armor, of the known iron-clads of the world which could enter these harbors. The powers of the guns necessary to penetrate these armors were then calculated, and the number of guns considered essential for a proper defence of the harbors was decided upon. In that determination the board was guided by a list of guns and mortars which had been prepared by the Board of Engineers for Fortifications after careful study of the subject. The board submits tables which embody its views and which, summarily stated, call for 125 eight-inch guns 21.5 feet long, to weigh 13 tons each and carry projectiles weighing 285 pounds; 226 ten-inch guns 26.875 feet long, to weigh 25 tons, and to carry projectiles of 575 pounds; 306 twelve-inch guns 35.11 feet long to weigh 48 tons and to carry 894 pound projectiles: 50 sixteen-inch guns 45.93 feet long, to weigh 107.77 tons, to carry projectile of 1,631.4 pounds each: 512 twelve-inch mortars 10.33 feet long. to weigh 13,06 tons and to carry 610 pound projectiles. These guns will have a penetrating force at 5,000 yards through thicknesses of wrought iron as follows: 8-inch calibre, 10.39 inches; 10-inch calibre, 15.16 inches; 12-inch calibre. 17,25 inches, 16 inches calibre 23 20 inches

In conclusion the Board states that it deems it of the utmost importance that the guns and mortars above specified should be procured at the earliest date practicable,

---

THE danger of incidental harm to the community, or to certain classes of people, from the increased use of machinery, the extension of public works, etc., is greatly diminished when those who make the laws, and especially those whose duty it is to interpret them, recognize that law is a progressive science; that it is a means, not an end; that when a state of things arises for which there is no precedent, a new precedent must be made. How the most enlightened jurists hold this principle constantly in view, and how the common as well as the statute law is thus made to keep pace with the general advance of civilization, is admirably set forth in the leading article in the *North American Review* for December, "Labor and Capital before the Law," by Judge T. M. Cooley, of Michigan. To the same number, William K. Ackerman contributes some suggestive "Notes on Railway Management," Dr. Schliemann tells what he found in his excavations of the ruins of Tiryns, in Southern Greece, and principal Shairp supplements his scholarly article on "Frienship in Ancient Poetry" with one on "Friendship in English Poetry." The other articles in the number are, "The British House of Lords," by George Ticknor Curtis, and "Responsibility for State Roguery," by John F. Hume.

INDIANAPOLIS, IND., November 23.—Articles have been filled incorporating the Eastern and Western Air Line Railway Company, which proposes to construct a continuous line running through the States of Iowa, Illinois, Indiana, Ohio and Pennsylvania. The capital stock is $52,000,000, divided into 526,000 shares; is estimated that the cost of constructing the road will be $50,000 per mile. The officers are: President, Thomas W. Osborne, of New York; Secretary, Clinton L. Conkling, of Springfield, Ill.: and Treasurer, Fred L. Matthews, of Springfield.

WATER.

A HUNDRED men are at work repairing the Little Falls, Wis., dam.

WATER pipes for the Abbott Run water, East Providence, R. I., are being laid from the main on Pawtucket Avenue to the cotton mill at Riverside, above the Central bridge.

THE prospects for a system of water-works at Catonsville, Md., are brightening in keeping with the general boom started by the completion of the Catonsville Short Line.

DANVILLE, ILL., acting under the advice of Chas. Hermany, the consulting engineer, has added a 5,000,000 gallon reservoir to its existing water supply. The reservoir is built near the Palmer Springs, and gathers the water from that excellent source.

FROM the report of Hubert O. Thompson, Commissioner of Public Works, New York City, we find that during the quarter ending September, 30th, the expenditures on funded debt for water supply was $222,504.04, and on revenue bonds for water meters $6 699.85.

WE clip the following from the Denver *Tribune*:—PUEBLO, Col., November, 17.—At a meeting of the South Pueblo Council, to-night, resolutions were adopted authorizing the Council to submit to the people, at the next election, a proposition for the city to create a bonded indebtedness, for the purpose of enabling the city to construct and own its Water-works, the present protection from fire which is furnished by the South Pueblo Water Company being declared inadequate.

THE longest tunnel in the southern hemisphere has been recently completed. It will conduct the waters of the Nepean and Cordeaux rivers in Australia to the Cataract River, at a point from which they will be led by a canal to Sydney to form the water supply. This tunnel, which is about 7 ft. in height by a little over 9 ft. wide, extends from the Nepean to the Cataract River, a distance of 4½ miles. It is three years ago last July since the contractors began to drive the tunnel through the sandstone.

THE fire engines in Italian cities are still the same little hand-pumps used in the beginning of this century; not a single steam fire engine exists on the peninsula, owing to the rarity of fires, but a movement is now on foot to introduce steam engines, according to the American style. The next step in the grand march of civilization in Italy, evidences of which on every side are so deeply deplored by many tourists, will be to erect buildings on the combustible American plan, so as to enable the gallant firemen to practice occasionally with their steam engines.

THE average rainfall in the Croton water-shed for three months was 14¼ inches. It diminished rapidly in September, so that it became necessary to draw upon the storage reservoirs and lakes. The aqueduct has been kept in good condition and the work of improving it has been advanced as far as possible. The depth of water in the new or large reservoir in Central Park was increased three feet by September 30th, in the old Central Park reservoir eleven feet, and in the Forty-second street reservoir eight feet, and the pressure or head of water in the distributing pipes throughout the city was increased an average of about eight feet in height. About 3¼ miles of water pipes were laid and 718 additional water meters were placed.

DIRECTOR Gardiner, of the New York State Survey, has made an alarming report to the State Board of Health upon the existing evils at the Albany Basin. This basin, in the immediate neighborhood of the leading hotels and a busy portion of the city, has been made a receptacle for the public sewage, until sewage-bars have formed and it is practically filled with filth of every description. The most dangerous feature in the case is the fact that Albany takes its water supply from a point only 1500 ft. from this basin, and on the ebb tide a current of polluted water is carried directly to the in-take pipes of the city water-works.

Mr. Gaidiner recommends that the city be prevented from using the basin as a point of discharge for its sewage, and that the Legislature be asked to make an appropriation for dredging it to a proper depth and so removing the existing filth.

A MEETING of the Joint Board to Prevent Pollution of the Passaic and its Tributaries met Saturday afternoon in the office of the Aqueduct Board. Commissioner Southard presided. An address was delivered by John W. Hyatt, who said that to deliver 15,000,000 gallons per day ten filters, twenty feet in diameter, would be required. This would cost from twelve to fifteen cents per 1,000,000 gallons extra. Filters, twenty feet in diameter, would cost $75,000. and the necessary buildings and pumping apparatus $25,000 extra.

A motion of Mr. Wismer that the Board recommend the Hyatt filter to the Newark Aqueduct Board and the Board of Public Works of Jersey City was adopted. A report was submitted by Prof. Leeds, showing analysis of the water, in which he said that the only difference in the water from the South Orange avenue reservoir and Belleville is an increase of mineral matter in the former.

Water Inspector Courter presented a lengthy report of the result of five years' inspection of the Passaic and its tributaries. Manufacturers and others on the representation of the Board had considerably abated the pollution of the waters. Many improvements had been made along the bank of the river at Belleville and opposite Passaic in Bergen county. At Bloomfield and Third River also there was a considerable abatement of the nuisance. Much benefit has resulted from educating the public mind up to the necessity of preventing pollution.

President Southard submitted a review of the five years' work of the Board. By a system of inspection the pollution had greatly abated, with little annoyance and demonstration as was possible. He then announced that this was his last meeting with the Board, and he thanked that body for its many kindnesses. Subsequently he offered a motion that a joint meeting of the committee on water supply of the Board of Public Works of Jersey City and the Newark Aqueduct Board be held in Jersey City on December 15, at 2 P. M. The motion prevailed.—*Newark, N. J., Press.*

THE SAYRE WATER-WORKS.

The Sayre Water-Works are now in operation, and furnish water to both Sayre and Athens, Pa. From a stone crib in the Susquehanna River, the water is led through 129 feet of 20" cast-iron pipe to the river's east bank; thence through a culvert 6' under the public road into a well 8 feet in diameter, internally, and 32 feet in depth, the bottom of the well being 7 feet below low water mark. From this well the water is drawn through a 14" suction pipe by a Worthington compound condensing pumping engine, with independent condensing apparatus, and sent to the reservoirs through a 12" force main. The capacity of the engine is 1,506,000 gallons per 24 hours, and on trial it was considerably increased. The steam boilers are two in number, each 13' long and and 54" in diameter, and were made at the Sayre P. and N. Y. R. R. shops. The engine house is of brick 32' × 56' and the chimney is 60' high, and 6' square at the base. There are two reservoirs, each having a capacity of 1,500,000, gallons, and when full there is a static head of 223' above the river at low water. The head on the streets of Sayre and Athens varies from 180' to 207'. The reservoirs are situated side by side on the hill above the engine house, were built by the Water company and are rectangular in shape with rounded corners. The greatest depth of water in them is 13' 6" and the banks rise 4' above the flow line. The banks slope 1½ to 1 on the inside and 2 to 1 on the outside. A 20" pipe connects the two reservoirs, and by a system of valves in the gate house, one reservoir only need be used, or either can be pumped into, and the water drawn from the other. The effluent pipe is a 16" for a short distance, reducing to a 10" main which is laid across the river into Sayre. An 8" pipe from Sayre supplies Athens. So far seven miles of piping have been laid. The laying of pipe, setting of hydrants, valves and special castings was done by Inman Bros., contractors, of N. Y. City, and was the only part of the work done by contract. All 8" and larger pipes was manufactured by R. D. Wood & Co.,—the 6" and 4" by the Sayre Pipe Foundry Co., The hydrants are of the "Mathews" patent, and the "Eddy" valves. The trenches for the pipe were excavated 5' deep, and in the river the top of the pipe was laid from 1' to 2' under the river bed. Only one of the reservoirs has been entirely finished—the other will be left until next spring before being concreted.

The finished one has 6" of concrete laid on 6" of puddle on both the bottom and sides,—the concrete extending up to within 2' 6" of the flow line. A heavy stone wall laid in cement, is placed above the concrete and extends to within 1' 6" of the flow line; above this is laid 2' 6" of dry stone wall, and the remainder of the slope is finished with broken stone. The concrete was given two light coats of cement. Very little of the plumbing in the dwellings has been done, but the consumption is already about 300,000 gallons daily. The engineer of the work is C. W. Knight, C. E., of Rome, N. Y.

A VERY deep well is being sunk at White Plains, Nevada, on what they call the 40 mile desert. The well is being put down by the Central Pacific Railroad Company as a test well, not alone for the satisfaction of obtaining water for their own use, but to determine the feasibility of getting it elsewhere on the line of their railroad, as well as in other parts of the State. The only good supply of water for the desert is brought from the Truckee River, 25 miles west of the new well on White Plains, and is hauled in tank cars for the supply of engines and domestic purposes, showing the necessity of testing thoroughly by artesian wells to get water. The desert contains many specimens of Indian curiosities—arrow heads, Indian mortars, etc., being formerly fine hunting grounds.

A record of the progress of this well will be of interest to many persons. They have found salt water, hot water, and finally, at the depth of 1,650 feet, they came across wood. From the surface to 20 feet they passed through clay with a 4 inch stratum of fine decomposed quartz; them to 36 feet it was tufa and cement; then 2 feet of cobbles, sand and hard shells. At 38 feet they struck a strong stream of salt water in gravel; from 40 to 70 feet there was the sand, cement with seams of rock

and cobbles. This kept on until they reached 144 feet, when they met cement clay, with sand and gravel which continued to 205 feet, when they met fine brown sand; then down to 300 feet there was cement, gravel, sand and shell conglomerate. From 300 to 340 feet compact sand or sand rock; to 367 feet various kinds of cobbles: then followed white tufa, find sand, cement, sand and gravel to 400 feet. A stratum of conglomerate was then found, which passed into cement of 420 feet, where cobbles and gravel were met with, and then fine sand; at 486 feet bed-rock was found. Eight inch driving pipe was driven to the depth of 486 feet, the part above this being all surface wash. From 486 to 520 feet was black rock, when red volcanic rock was met, continuing with slight change to 575 feet, where black basalt was found. At 595 feet there was red rock and red mud; then came black rock with seams of clay. From 625 to 635 feet there was a reddish gray rock with cement, which mixed up with the water, red rock probably from above. Gray muddy rock then came in, and from 655 to 665 feet a reddish brown sand rock; then a soft green rock. Between 665 and 685 feet there was very compact black sand, and then hot water was struck.

Between that point and 697 feet was a reddish black sand, changing to coarser below, when at 703 they found red rock again, which continued to 745 feet. From there to 950 feet was black, red and gray rock in strata. From there to 1,000 feet, and to 1,040 feet, was red rock, fine and very hard. From 1,040 to 1,050 the rock was slate colored. From that to 1,140 black (basalt), and then a red, slaty clay, followed by blue clay (slate) and volcanic ash. The volcanic ash continued to 1,300 feet, when conglomerates and rock were met, lasting to 1,550 feet, when a soft, muddy, white rock came in, continuing to 1,610 feet. From 1,610 to 1,615 feet was a fine gray sand, and from 1,615 to 1,624 was a stratum of wood. This wood is not silicified, but is black and hard, though it breaks when handled. Some large pieces were found. It is rather remarkable to find wood at such a depth, and so thick. Iron pyrites were found near by. Below this, again, is conglomerate, with some fine sand. At 1,825 feet very muddy rock came in, and more sulphurets, followed by a dark rock, very loose, and falling in on the drills. From 1,890 feet to 2,088 feet very hard black rock was met. The well is now down over 2,100 feet, but no water has yet been found, aside from what is hot or salt, as memtioned. The work of sinking is, however, being continued, with the hope of eventually striking a flow of water.

NEWS OF THE WEEK.

Railroads and Canals.

WORK on the extension of the Lake Erie & Western to Peoria was begun last week.

THERE are several elevated road projects under discussion by which the various railroads are to get into the heart of Baltimore.

THE new railway station at Birmingham, Eng., cost nearly $2,000,000, and is the largest in the world.

THE completion of the Erie and Wyoming Extension gives the Lackawanna coal regions a through route to tide water without breaking bulk.

THE Texas and Pacific Railway Company has negotiated a loan of $700,000, to build a a branch from Prudhomme Station to Natchitoches.

TRAVEL between Monterey and New Laredo, on the Mexican National railway, which has been suspended for some time by the destruction of the bridge over the Salado river, has been resumed.

IT is reported that the Attica, Lockport and Lake Ontario Railroad chartered and surveyed last year, will be built within the next twelve months. The Hon. R. S. Stevens of Attica is the leading spirit in the enterprise.

THE last spike was driven Friday, Nov. 21st., in the connection of the Clinton branch of the Burlington, Cedar Rapids and Northern with the new track just completed from Elmira, Iowa, on the main line of the road.

INDIANAPOLIS, IND., November 18.—The Indiana, Bloomington and Western is completing a switch at New Madison, O., whereby the Middle Division and the Cincinnati, Van Wert and Michigan will be connected.

WORK has been begun on an extension of the San Francisco and North Pacific road from its present terminus at Cloverdale, Cal., northward into Mendocino county, through a country heretofore without railroad facilities.

PROVIDENCE, R. I., is agitated by the question of improving its railroad facilities and removing a nuisance known as "the cove," by filling in the latter. The coming election of common councilmen will settle the matter one way or the other.

MR. GOULD is said to have lately contracted for 25,000 tons of steel rails, to be delivered at St. Louis during the coming year, to be laid upon the roads composing the Southwestern system, making a total of 35,000 tons that have recently been contracted for to be laid upon those roads,

EX-GOV. EVANS, of the Denver and New Orleans road has concluded a contract for the construction of the Denver and Texas Central railroad from Albany, Tex., to a connection with the Fort Worth and Denver City, road, and from the latter line to the northern boundary of Texas, where it will connect with the Denver and New Orleans road.

THE much needed bridge over the tracks of New York, New Haven and Hartford and the New York and New England roads at Asylum St., Hartford, Conn., will now be built. The commission, appointed by the Legislature to determine the location and plan for a bridge, located, on Nov. 21, the bridge in the present line of the street, and decided that it be of iron with earth approaches.

PITTSBURGH, PA., NOV. 20.—The projectors of the proposed air line railroad from New York to Council Bluffs, Ia., will meet at Springfield, O., Tuesday, December 2, to complete the necessary preliminaries for building the road. It is stated on good authority that upward of $2,000,000 of the capital stock has already been placed. The capitalists thus far represented are principally Eastern men. It is also intimated that a number of English railway magnates have purchased considerable stock. The nearest point to Pittsburgh through which the line will pass, is Butler, Pa.

AN article in the *Deutsche Grundeigenthum* shows how extraordinary railroads have increased the growth of inland capitals. In 1740 Berlin was already the capital of a powerful kingdom, but its situation was such that the farmer in bringing his goods to market over the bad roads consumed on the journey more than one-half their market value, and great difficulty was felt in provisioning a large population. When, in 1843, the influence of railroads first began to be felt, Berlin had 330,230 people; in 1861, 547,000; in 1871, 826,000; in 1881, 1,122,300—an increase of nearly 800,000 in thirty-seven years. Madrid's growth is largely due to like causes.

THE Weld County Ditch Company, of Colorada, which was organized last spring, is preparing to push its large canal. P. W. Putman is President, George West, Secretary and Treasurer, C. D. Page, Engineer, of the company. The contract for completing the entire canal has been let to the well-known contrator, W. C. Bradbury; of Denver, who is to begin work with a large force this week. The ditch, fifty miles long, will leave the Platte River fourteen miles below Greeley and cover the Kiowa and Fort Morgan flats. It is understood that the Company has plenty of money. The capital stock is $300,000. The enterprise was incorporated last March and the engineer work begun in June.

THE origin of the railroads is by some writers believed to be unknown. There is in the British Museum an Egyptian hieorglyphic which represents slaves drawing stones over a road like a primitive tramway. One writer would have us believe that a similar device was known in China many years ago. While it is admitted that printing, gunpowder and many other things were familiar to the Chinese before they were known to Western civilization, yet it is highly improbable that anything approaching a tramway, nearer than a palanquin, was known to them. The earliest authentic mention of a railway occurs in the life of the Lord Keeper, Roger North, early in the seventeenth century. About 1670 a double parallel line of wooden beams was laid at Newcastle on Tyne, and a large cart with four rollers, drawn by horses, was used to transport coal from the mine to the river. A flange placed at the side of the beam kept the carts from rolling off the rail. So successful was the experiment that other coal districts in England and Scotland followed the example. It was a great labor scheme, for a horse that could with difficulty draw only 1,700 weight without the aid of this smooth road could now with ease draw 4,200 weight. This was the earliest tramway, the precursor of the steam railway. The first improvement made on this tramway was the laying of iron plates on the wooden beams; this contrivance reduced the friction and made less wear and tear. In 1768 rails made wholly of iron were used, and in 1789, when William Yessop built the first public railway in England, at Loughborough, he introduced the edge rail of cast-iron and changed the flange from the rail to the wheel. Finally, in 1808, the rails were made of malleable iron.

Miscellaneous.

MILAN, O.—Water-works will, in all probability, be built here at an early day.

AN agitation is on foot for the construction of a main sewer along the line of the Rosedale Creek from Yonge street to the Don in Toronto, Canada.

The Legislature of Georgia has voted to go on with the construction of the State Capitol under the present contract with Mr. Horne of Ohio, and not to discriminate in favor of State quarries.

NEARLY all the iron work of the Brooklyn Elevated Road is up, the cross-ties are laid in Park Avenue, and by December 1 those on Grand and Lexington Avenues will be in place. The string pieces are ready to be delivered, and it is to be expected that the rolling stock will be on the tracks before March next.

STONE AND BRICK WORK AT DALLAS, TEX.—The following is a synopsis of the bids for stone and brick work of the basement and area walls of the court-house, etc., at Dallas, Tex.:

M. D. Faulk, Dallas, Tex., $60,000.
Brownlee & Co., Dallas, Texas, $17,963.
No award has been made.

STONE AND BRICK WORK AT JEFFERSON CITY, MO.—The following is a synopsis of the bids for stone and brick work of the basement walls of the court-house, etc., at Jefferson City, Mo.:

J. M. Rice, Austin, Ill., $16,985.
J. McCarthy, Washington, D. C., $13,670
J. H. McNamara, St. Louis, Mo., $14,890.
No award has been made.

THERE are great differences in the average growth of some of the more common trees. In twelve years white maple increases 1 ft. in diameter and 30 ft. in height; ash, leaf maple or box elder, 1 ft. and 20 ft.; white willow, 1½ ft. and 50 ft.; yellow willow 1½ ft. and 35 ft.; blue and white ash, 10 in. in diameter and 25 ft. in height; Lombardy poplar, 10 in. and 40 ft.; black walnut and butternut, 10 in. and 20 ft.

THE engineers of the Croton Aqueduct are preparing a new use for the electric light. Instead of the old-fashioned rod, illuminated with a lamp, at which sights were taken with the transit during the operations in the tunnel, a plumb bob, attached to a platinum wire, will be used in connection with a portable battery, which will make an incandescent line of light where the wire is suspended. Greater accuracy will be secured, and the apparatus will be less difficult to manage than the old lamp and reflector.

EAST BREAKWALER AT DUNKIRK, NEW YORK.—The following is an abstract of proposals received by Captain Maguire for Dredging the channel and repair of East Breakwater at Dunkirk, New York:

Hingston and Woods, Buffalo, N. Y.: 37,000 cubic yards of dredging, 18c. per cubic yard; total $6,660. Removing old work, 21,000 ft. b. m.,10 per foot: total $210. White oak 23,400,ft. b. m., $40 per foot; total, $936. Drift bolts 5,000 lbs., 6c. per lb.; total, $300. Sheet iron, 100 lineal feet, 96c. per foot; total, $96. Grand total, $8,202.

Louis P. Smith and James A. Smith, Cleveland, Ohio; dredging, 30c. per cub. yd.; total, $11,100. Removing old work $7 per foot; total, $147; white oak, $40 per foot; total, $936. Drift bolts five cents per pound; total, $250. Sheet iron $1 per pound; total $100.

Contract awarded to Hingston and Woods.

THE twin-screw steel steamer, Mackay-Bennet, built and engined by Messrs. John Elder & Co., Fairfield, Glasgow, expressly to serve as a cable-repairing ship for the Commercial Cable Company, made her trial trip on the same day. In six consecutive runs on the measured mile she attained a mean speed of 12.4 knots per hour. The steamer was subsequently taken out into the open sea so that a trial might be made of her steering apparatus, to which the attention of the builders had been specially directed, in consequence of the recent failures of twin-screw steamers. She made a complete circle with one engine, without the rudder, in 4 minutes 40 seconds, and with the aid of the after rudder, the time was reduced to 3 minutes 20 seconds. The steering was so satisfactory to the officials who were present on behalf of the owners that the bow rudder was not called into requisition. The bow and stern paying-out and picking-up gear were constructed and fitted on board by Messrs. Elder & Co. for Messrs. Siemens Brothers & Co., to whose work the Mackay-Bennet proceeded on the following day to receive her cable, electrical apparatus, etc. The vessel was built under the special superintendence of Mr. St. Clare, Byrne, of Liverpool.

A DESPATCH from Kissimmee City, Fla., says the Okeechobee Land Company's drainage canal, between Lakes Tohopkaliga and East Tohopkaliga, which has been ready for the final opening for about two months past, was cut through to the East lake. The fall was so great between the two lakes that, though the canal is 8 feet deep and 36 feet wide, a current was at once started at the rate of 12 miles an hour. Chief Engineer Kraemer telegraphs that there was no damage done by the sudden flow of water and that the opening of the canal was in every way a success.

CANADA dispatches speak of the discovery of a new lake, 360 miles west from lake St. John. The general tend of the lake, as far as known, is from the southwest to the northeast, stretching away from Foam Bay, and the height of the land in the southwest to an unknown, distance towards East Maine and Labrador. The waters swarm with fish of all kinds, and fur-bearing animals are abundant. The climate is agreeable and suitable for agricultural purposes. It is stated that the Hudson Bay Company have had their agency there for upwards of a hundred years, but have held it a secret that a lake of such dimensions ever existed. It is supposed to be as large as Lake Superior.

DURING the past fiscal year, as shown by Commissioner Butterworth's report, there were granted, including reissues and designs, 22,822 patents. The receipts from all sources were $1,145,433, an increase of $49,548 over the receipts during the preceding year. The expenditures excluding printing, were $901,413, leaving a surplus of $244,019. The increase during 1884 over the number of applications for patents, designs, etc., received during the preceding year was 3,088. The number of applications awaiting action by the office on June 30, 1884, was 9,186, an increase of 5,087 over the accumulated applications at the end of the preceding year.

THE history of all great inventions shows that their development is of slow growth, for example, gas, common illuminating gas, was first made by Dr. Hale, in 1726. Then Watson in 1750; Lord Dundonald in 1786; Murdock in 1792. Windsor formed the first gas company in 1803, and lighted Pall Mall, London, 1807; the streets of London and Paris in 1815; Baltimore in 1816; Boston 1822; New York in 1825. This has been truly called the age of invention. Wilkie says: "One of the grandest rolls in the great drama of human progress has been filled by invention. Invention and civilization have come up out of the ages hand in hand. Fancy for a single moment what this world would be if deprived of the inventions of the Stevensons, the Morses, the Fultons, and others of their kind.

DREDGING IN SUSQUEHANNA RIVER.—The following is an abstract of the bids for dredging in the Susquehanna River received by General Wm. F. Smith, U. S. Agent:

American Dredging Co., Philadelphia, Pa., 14 7-8c. per cubic yard, measured in scows, and 19 7-8c. measured in place.

Daniel Constantine, president Baltimore Dredging Co., Baltimore, Md., 17c. per cubic yard measured in place, and 12 7-10c. measured in scows.

P. Sanford Ross, Jersey City, 16c. per cubic yard, measured in scows, and 21c. measured in place.

James Caler & Son, Norfolk, Va., 16 1-2c. per cubic yard measured in scows.

Frank C. Somers, Philadelphia, Pa., 13¾c. per cubic yard, measured in scows.

Morris & Cummings Dredging Co., New York 19 1-2c. per cubic yard, measured in scows.

Contract awarded to the Baltimore Dredging Co.

CALIFORNIA LAND OFFICES.—The United States Surveyor General for this State draws $2750 a year. His office is in this city. His chief clerk is paid $2,400; three other clerks, $2000 each; one clerk, $1800; two clerks, $1200; eight copyists, $900 each; one messenger, $900; office boy, $360; chief draftsman, $2200; three draftsmen, $2000 each; three draftsmen, $1800 each; two draftsmen, $1600; five draftsmen, $1500; one draftsman, $1400, and one $1200.

There are eleven United States Land offices in this State, each having a Register, a Receiver and one or more clerks. One of the offices is located in this city and has two clerks at $1200 per year each. The Register and Receivers each receive $500 a year and are allowed fees up to $3000.

There are eight Californians holding Consular positions under the Government in foreign countries.

The officers in the Coast and Geodetic Survey are appointed by the Secretary of the Treasury and cannot be deprived of their positions on political grounds.—San Francisco *Chronicle.*

THE filling in of the bridge approach on the west side of the Seekonk has been nearly completed.

THE Court of Appeals of Virginia has affirmed the decision of the lower Court in the case of the Kendall Bank Note Company of New York, against the State of Virginia, through the Board of Sinking Fund Commissioners. The Kendall Company in 1882 were the competitors of the American Bank Note Company, New York, for printing the bonds of Virginia, under the Redleber act, and obtained the contract, After a portion of the work had been completed and delivered, one of the Board of Commissioners turned over and voted with others to annul the contract and give it to the American Company. Upon this the Kendall Company brought suit in the circuit court, Richmond, and obtained judgement for $30,000 with interest from July, 22, 1882. The most important point decided was that a party whose contract was rescinded, through no fault of his own, is entitled to prospective profits. Edgar Allen, counsel for the Kendall Company, will present to the Legislature a petition asking for an appropriation to pay the judgement, which will aggregate, with interest, etc., nearly $35,000.

REPORT OF THE LIGHTHOUSE BOARD.—WASHINGTON, D. C., November 17.—In the annual report of the Light house Board $225,000 is asked for lighting and buoying rivers; $150,000 is necessary to continue work on the lighthouse at Northwest Seal Rock, off Point St. George, Cal. It is recommended that the lighthouse districts which embrace the upper lakes be divided, the portion embracing Lake Michigan and Green Bay to be set off and called the Seventeenth District; the remainder to be included in the present Eleventh District, and to be known by that name. It is also suggested that another lighthouse district be made by dividing the Fifteenth District at Cairo, Ill., leaving that portion of the Mississippi between the mouth of the Ohio River and New Orleans, including the Red River, as a separate district, to be called the Sixteenth, with headquarters at Memphis. Estimates for general appropriations for the next fiscal year, including supplies, repairs, salaries, expenses of light vessels and fog signals, etc., are $2,164,000; estimates for special appropriations amount to $1,261,550, made up in part of the following items; Port Sanilac Light Station, Michigan, $10,000; Pipe Island Light Station, Michigan, $10,000; Milwaukee Light Station, Wisconsin, $15,000; St. Mary's River ranges, Michigan, $12,000; Angeliston and fog signal, California, $45,000; Cape Oxford Light Station, Oregon, $2,000; Destruction Island Light Station, Washington Territory, $85,000; supply steamer, $150,000; building for lighthouse, $25,000.

STONE FOR DELAWARE BREAKWATER.—The following is an abstract of the proposals received by Major W. H. Heuer for furnishing stone for the Delaware Breakwater Harbor:

Charles H. Edwards, Quincy, Mass., 10,000 tons at $3.18 per ton; 13,000 tons at $3.78 per ton.

Mt. Waldo Granite Works, Frankfort, Me., 10,000 tons at $4.47; 5,000 tons at $4.97, and 8,000 tons at $5.47.

Wm. A. Browne, Brooklyn, N. Y., 23,000 tons at $3.74.

James Symington, New York city, 23,000 tons at $2.58.

John. S. Howell, New York city, 23,000 tons at $3.39, for samples 3, 4 and 8, and $2.95 for samples 2, 5 and 7.

Opperman & Shoemaker, Harrisburg, Pa., 23,000 tons at $3.19.

John A. Bouker, Jersey City, N. J., 23,000 tons at $2.73.

Chas. A. Brown, Elizabeth, N. J., 23,000 tons at $1.74.

Smith and Ward, Philadelphia and Ridley Park, Pa., 23,000 tons at $2.59.

Andrews and Locke, Baltimore, Md., 23,000 tons at $1.99.

Parker and Sylvester, Rockport, Mass., 23,000 tons at $3.17.

Conshohocken Stone Quarry Co., Philadelphia, Pa., 23,000 tons at $2.37½.

Wm. A. Cumming, Stamford, Conn., 23,000 tons at $3.63.

Wm. C. Watson, Philadelphia, Pa., 10,000 tons at $4.50.

Geo. G. Leiper, Chester, Pa., 10,000 tons at $3.33.

Leiper & Lewis, Chester, Pa., 10,000 tons at $3.47.

McClenahan and Bro., Port Deposit, Md., 13,000 tons at $4.13.

Jas. M. Andrews, Bellevue, Del., and Geo. Willett Andrews, Biddeford, Me., 8,000 tons at $2.25, and 15,000 tons at $2.00.

Contract awarded to Chas. A. Brown.

THE canals of New York will close December 1.

ONE hundred and fifty miles of new track will be laid by the Atlantic & Pacific Railway next year, which will extend from the central division in Indian Territory toward Albuquerque.

CHICAGO, Nov. 22: Despairing of getting the Van Buren street bridge open by the ordinary means at their control, the city authorities decided to use the "hair-of-the-dog-that-bit" method, and at 8 o'clock yesterday morning a line was taken from the east end of the wedged bridge to the propeller Rochester, and a line to the propeller Philadelphia from the opposite side and draw. After these lines were made fast to the capstans of the vessels, the bridge was jacked up on rollers, and after considerable hord pulling on the lines by both vessels the bridge was loosened and swung, and navigation in the South branch was again opened.

THE NEWARK N. J. SEWER BIDS.

Messrs. Schaffer and Adams, after one of the hardest day's figuring of their lives, solved the problem as to which was the lowest of the several bids for the construction of the improved system of sewerage for the city, and when the committee assembled at four o'clock on Saturday afternoon they presented the following report:

B. & J. F. Shanley,	sect's	1 to 5	....$299,964.92
James Smith,	"	"	.... 313,662.00
Thomas McGrath,	"	1, 2 & 3	.... 214,337.20
James Smith,	"	"	.... 204,706.00
B. M. & J. F. Shanley,	"	"	.... 200,235.45
Ross & Sandford,	"	4 & 5	.... 101,178.33
James Smith,	"	"	.... 108,956.00
B. M. & J. F. Shanley,	"	"	.... 99,729.47
Miles Tierney,	"	2 & 3	.... 131.597,00
James Smith,	"	"	.... 132,931.00
B. M. & J. F. Shanley,	"	"	.... 130,660.55
Thomas McGrath,	"	"	.... 144,375.70

As soon as the engineer had explained the several bids, showing that the Messrs. Shanley were the lowest bidders for all the work, Alderman Dusenberry moved that the contract for the work be awarded to B. M. & J. F. Shanley for the sum mentioned.

For the sum named, $299,964.92, the entire work on the conduit, except the pumps and machinery, is to be turned over to the city complete, as set forth in the specifications of the engineer.

Leaving $40,000, the estimated cost, for the pumps and machinery, and $16,000 for the construction of the Tenth ward ditch, the full amount of the award is $31,000 less than the engineer's estimates, or $44,000 less than the amount named by the advocates of the measure in the council.

The contractors who have been dredging the "big ditch" completed their work on Friday, and Alderman Connelly called attention to the fact that while the work ordered by the Council under the contract had been finished, still the sewer is not in a condition to do the whole work for which it was designed, and as he was informed that the contractors are willing to do the amount of dredging necessary to place the ditch in proper condition and relieve the city of existing nuisances, for half the price paid for the other work, he was of the opinion the whole job should be finished. "If," said the Alderman, "the city could afford to spend $12,000 for the work now done, which only partially does the work, there should be little hesitation in spending $6,000 or $7,000 more to make the sewer complete, so as to protect the people from contagious diseases, and that the health of the people in that section of the city should not be endangered."

It was then agreed that the contractors proceed with the dredging and banking of the ditch as far as the balance of the appropriation would allow, and that the Council be asked to appropriate an additional sum of $7.000 to finish the work.

Alderman Connelly then moved that four inspectors for the new sewage system be appointed, two from each party, at a salary of $5 per day. He said that his reason for fixing the pay at that figure was so as to secure the services of competent and faithful men.

Alderman Wilcox thought the pay too much and Alderman Dusenbury thought four dollars a day would be good pay for such work, but Alderman Connelly said that very few men could work in the meadows a week without getting malaria, and for such work, under such circumstances, good pay should be given. A compromise was, however, finally effected and the pay fixed at four dollars and fifty cents per day.

On account of the almost inhabitable condition of the City Surveyors office, it was resolved to secure the Committee on Public Buildings to secure rooms for the Engineer and Surveyor outside of the City Hall.—*Newark Press.*